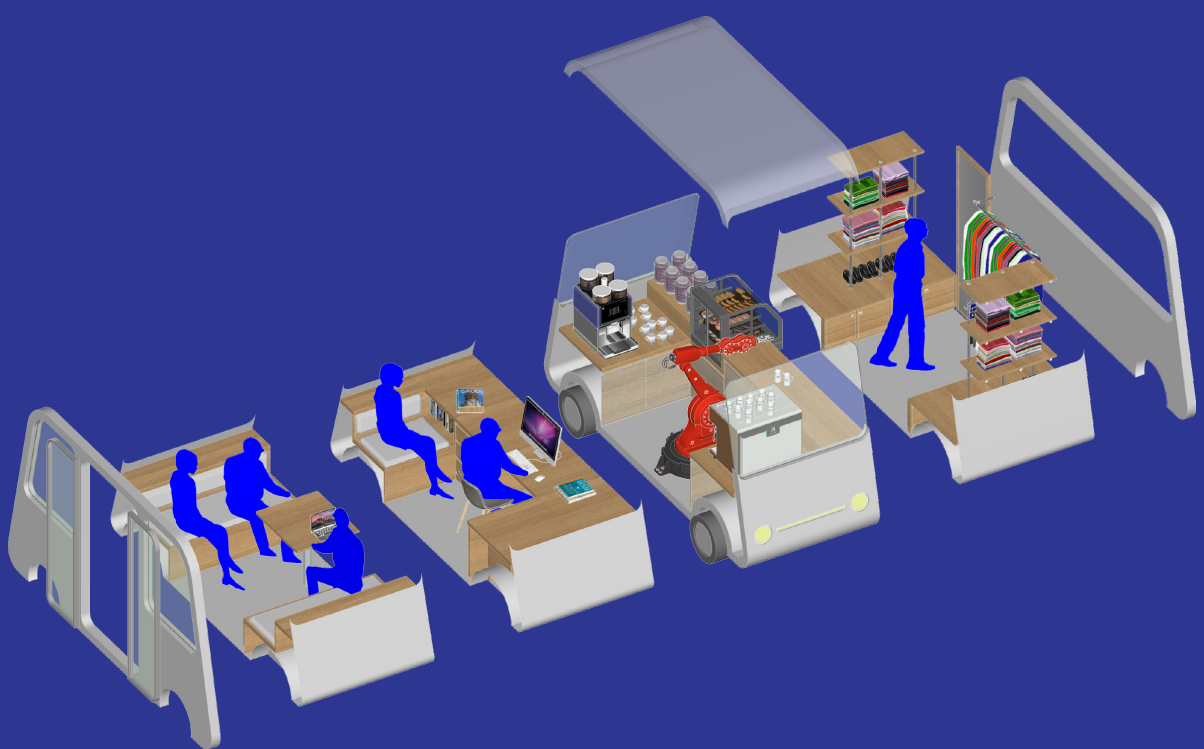
Mef University
Graduate School of Science and Engineering
Master of Science in Architectural Design
Alternative Architectural Practices

The Trace of the Automobile on Urban and Architectural Space



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2023

First of all, I would like to thank my thesis advisors Sevince Bayrak and Tomris Akın for their support, encouragement, interest in the subject, supportive sharing and always constructive criticism throughout the research process. In addition, I would also like to thank our dear studio executive Oral Göktaş and Alter8 team, who made a real teamwork possible during the master's degree, and my family who always stood by me with their moral and material support.

Abstract

This research focuses on how the automobile, which is experiencing the greatest evolution in its history, can affect the production of urban space and daily routines. The potential effects of smart cars, powered by electricity and transferred from human beings to artificial intelligence, on urban space and infrastructural elements that make up urban space are emphasized. In addition to the evolution of the automobile, discussions have been made on the possible effects of societies' tendencies towards new mobility trends on urban space. In this context, in the first part of the thesis, it is discussed how the automobile, which is one of the most important inventions of the industrial revolution, transforms the daily routines and overthrows the traditional city with its inclusion in daily life and the freedom it has given to human beings. The ideal and utopian cities of the modernists, who produced ideas about how the post-automobile city should be, are mentioned. In the second part, discussions about how electric and driverless vehicles can transform the production of urban space are continued through various speculative projects, current news and reports. In this context, the envisagements, project texts, videos and images made by the automobile industry and architects about the city of the future were examined. Based on the discussions made, original diagrams were produced and it was tried to provide a better examination of the subject. In addition, current newspaper news about the automobile industry and the reports published by various research companies contributed to the deepening of the subject.

Key Words: Architecture and Automobile, City and Automobile, 15-minute City, Shared Transport, Autonomous Vehicles, Electric Vehicles, Future Mobility, Shared Space

Science Code: 80107

Özet

Bu araştırma, içinde bulunduğumuz çağda tarihinin en büyük evrimini yaşayan otomobilin, kentsel mekanın üretimini ve gündelik rutinleri nasıl etkileyebileceği üzerine odaklanmaktadır. Elektrikten güç alan, kontrolü insanoğlundan yapay zekaya devredilen akıllı otomobillerin, kentsel mekan ve kentsel mekanı oluşturan altyapısal elemanların üzerindeki potansiyel etkileri üzerinde durulmuştur. Otomobilin evriminin yanı sıra, toplumların yeni mobilite trendlerine karşı olan eğilimlerinin, kentsel mekan üzerindeki olası etkileri üzerine tartışmalar ortaya konulmuştur. Bu bağlamda tezin ilk bölümünde sanayi devriminin en önemli icatlarından biri olan otomobilin, gündelik yaşamın içine dahil olması ve insanoğluna kazandırdığı özgürlükle birlikte gündelik rutinleri nasıl dönüştürdüğü ve geleneksel kenti nasıl alaşağı ettiği tartışılmaktadır. Otomobil sonrası kentin nasıl olması gerektiğiyle ilgili fikirler üreten modernistlerin ideal ve ütopik kentlerine değinilmektedir. İkinci bölümde ise, elektrikli ve sürücüsüz araçların, kentsel mekanın üretimini nasıl dönüştürebileceği hakkındaki tartışmalar, çeşitli spekülatif projeler, güncel haberler ve raporlar üzerinden sürdürülmüştür. Bu bağlamda, otomobil endüstrisinin ve mimarların geleceğin kenti ile ilgili yaptıkları tahayyüller, proje metinleri, videolar ve görseller incelenmiştir. Yapılan tartışmalardan üzerinden yola çıkarak özgün diyagramlar üretilmiş, konunun daha iyi irdelenmesi sağlanmaya çalışılmıştır. Ayrıca otomobil sektörü ile ilgili yazılmış güncel gazete haberleri ve çeşitli araştırma şirketlerinin yayınladıkları raporlar konunun derinleştirilmesine katkı sağlamıştır.

Anahtar Kelimeler: Mimarlık ve Otomobil, Kent ve Otomobil, 15 Dakikalık Kent, Paylaşımlı Hareketlilik, Otonom Araçlar, Elektrikli Araçlar, Geleceğin Mobilitesi, Paylaşımlı Alan

Bilim Dalı Sayısal Kodu: 80107

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Introduction

Undoubtedly, the automobile, which is one of the most important inventions of the Industrial Revolution, has been one of the most important figures of everyday urban life since its existence. The automobile has become one of the most critical components of daily life in the modern era and has also become a significant player in the production of urban spaces. The movement of the car, its dimensions, its belonging to the individual and its storage when not in use formed the determining criteria in the construction of the modern city. Before the automobile, urban spaces centered around humans, but suddenly, even though it was a human-controlled object, it focused on a machine that accelerated with the pedal pressed by humans. It enabled the fragmentation of the traditional city boundaries and the spread of the city to larger areas. In other words, the automobile became a revolutionary machine that radically changed the fate of urban space. In the present era, the automobile industry is undergoing the greatest evolution in its brief history. Fossil fuel vehicles with internal combustion engines are being replaced by smart, silent and electric cars without exhaust. The control of the car, which is managed by the human with the steering wheel, is transferred to artificial intelligence. The concept of mobility is completely changing. How will urban space, which has been transformed as a result of the concept of mobility, which has completely transformed with the automobile becoming one of the important parts of daily life in the 20th century, respond to the evolution of the automobile? How will smart and electric vehicles determine the fate of urban space?

The relationship between automobile and architecture, which is at the main focus of the thesis, is related to the processes during the master's degree. Within the scope of the master's, a research project on the issue of micro-housing was carried out as a team of 10 people. The emergence of the micro-living issue, its historical development and how it finds its place in daily life were tried to be understood. Various discussions were held on the sociological, economic, technological, ergonomic and architectural dimensions of the idea of micro-living. As a result, the research book in which all these studies were compiled was published as open source.[1] In the second period, the micro-living unit named Volu-te, which emerged with the aim of

1. Alternative Architectural Practices Graduate Program, ed., Alternative Architectural Practices Research Book, Last modified 2020, https://www.yumpu.com/en/document/read/65263911/aap-smal-scale-decent-change.

Figure 1: Micro-living unit Volu-te

filling a gap in the need for temporary accommodation in a metropolis like Istanbul, was designed. Volu-te was produced in the factory of Fibrobeton, one of the sponsors of the graduate program, and placed in the garden of MEF University (Figure 1). The interest in the relationship between the automobile and architecture, which is the main focus of the thesis, emerged in all these research, design and production processes. The dream that an architectural object could be produced as a mass-produced object, like an automobile, helped lay the foundations for the subject of the thesis. However, the focus has evolved over time, with the realization of how influential the automobile, which has a very important place in daily life, is in shaping the urban space we live in today.

The automobile, which is one of the most important actors in the construction of modern cities, holds an important place in human life. After the Industrial Revolution, humans, who were trying to keep up with the speed of everyday life, tried to adapt to modern life with the automobile. While the speed of the automobile gave mobility back to the individual, it also gave him/her freedom. Before the automobile, human beings, who were confined to a very limited area and trapped in their own shell, were able to travel easily to distant points they had never imagined before, in order to use their free time and carry out various activities, to live in a different location from where they worked and earned money, and to be wherever they wanted to be whenever they wanted. Moving from being a necessity, it has become a matter of pleasure in accordance with the individual's choice. Before the automobile, the city consisted of an area that could be traveled by electric trams, horses and carriages, or on foot. With the increase in human mobility and the capacity for relocation due to the automobile, the city began to spread to wider areas. Therefore, human daily routines and everyday life habits began to change. With the automobile, the concepts of time and space have also changed. Before the automobile, the distance between two points was considered as distance; but with the inclusion of the automobile in daily life, it began to be defined by the time spent during the drive.

As Corbusier described it, a city made up of building islands surrounded by highways that allowed the acceleration and movement of automobiles defined modern cities. The surfaces connecting two different points where automobiles could accelerate, the highways, became one of the most important components of cities after the automobile. Besides highways, many building typologies have emerged for the automobile and its

passengers, which have become an essential object of the modern era. Examples include restaurants, motels, gas stations, and shopping centers located along highways that can meet the basic needs of the automobile and its passengers. In addition to these, the preservation of stationary cars has become an important program in the agendas of urban and architectural production. Car parks have emerged so that individuals who go to work or return home from work in the high-density city, go to the cinema, concert, shopping, hospital, can store their vehicles. In other words, parking spaces were needed for each stop of the car, and these were quite diverse: open car parks, curbside on-street parking lots, multi-storey indoor car parks and private car parks, which are usually located in the basement of the building… The existence of the automobile has led to the opening of new fractions in the production of urban space and architectural practice. To summarize, the automobile, one of the most important elements of modern life, is a provocative object that succeeds in transforming the traces of the space it is in.

Since its existence, the automobile has been in a close relationship with urban space and architectural form. It played an important role in the construction of the built environment. It has led to the construction of multi-lane highways for speed, and the construction of numerous car parks for storage when not in active use. Pedestrians were thrown into the background and condemned to the sidewalks left over from the car, and the streets where children used to play were left to the car's dominance. In order for the car to be able to move uninterrupted, the highways divided the neighborhoods into two, and under/overpasses were built so that the pedestrians could cross the street so that even the traffic would not be interrupted. The production of urban space is almost entirely the result of the comfort of the automobile and its driver. The pre-automobile city was a pedestrian-oriented public space where pedestrians could roam freely, gather and exchange ideas. The dominance of the automobile has succeeded in overthrowing the urban space, a pedestrian-oriented public space. However, this situation seems to change completely in the near future. The car is breaking out of its conventional boundaries with which we are familiar. In the not-too-distant future, a traditional driver-driven car is expected to be replaced by electric and self-driving vehicles controlled by artificial intelligence. In this thesis, discussions continue on how the modern city, which the traditional automobile was instrumental in building, will transform and potentially be affected by the automobile of the future.

Today, the automobile, which is only a means of transportation and carries human beings from point A to point B, is a machine that can continue its activities at the will of man and serves a single purpose. Therefore, the interaction of today's car with the physical environment and the citizen is possible with the driver behind the wheel. When it is not in use, it is nothing more than a machine that is reserved for itself, waiting motionless in the parking lot that covers large areas in the city. In our age, the automobile is perhaps making the greatest evolution in its short history. Auto companies dream of more than just developing and launching a vehicle. They dream of supporting the mobility of urban space, becoming a part of daily routines and living spaces, being a part of the digital ecosystem created with mobile phones in our age. While realizing all these, it aims to get power from sustainable energy sources with the dream of zero carbon.

Fossil fuel vehicles with internal combustion engines, which have very high carbon emissions, are becoming a thing of the past. Quiet and electric vehicles, powered by rechargeable batteries and without exhaust, have already begun to decorate the streets. Just like the mobile phones we own, plugging in and charging cars leads to the establishment of new charging stations and infrastructural elements in everyday urban life. The possibility of charging at any point where the electrical infrastructure is suitable seems to reduce the dependence of vehicles on gas stations. It is a matter of great curiosity what will happen to the gas stations located on lands with significant real estate value in today's city. How will electric vehicles, the new toy of the new era, affect the fate of gas stations? With the technologies we have now, charging an electric car takes much longer than filling the tank of a vehicle with an internal combustion engine with gasoline. Therefore, the vehicle owner has a time when he has to wait while charging. So, can the time he/she has to wait be transformed into productive and quality time?

It seems that the evolution of the automobile will not be limited to electric vehicles only. It seems that smart and driverless vehicles equipped with superior artificial intelligence hardware and software, various sensors and cameras will become important parts of the city of the near future. In the scenario where the driver and steering wheel disappear, a future where we will see self-driving autonomous vehicles on the roads does not seem too far away. Transforming the automobile into an autonomous machine that can process the data it receives from its environment and make its own decisions, being a part of the sharing economy, and continuing its activities

spontaneously to pick up another passenger or to search for a parking space after disembarking the passenger will be instrumental in transforming the destiny of the urban space.

The decreasing trend of vehicle sales rates and the rise in demand for shared mobility applications may also give some clues about the fate of urban space. According to many studies, the fact that cars support the fully autonomous driving mode and start to be used in a shared manner shows the potential to reduce the total number of cars needed. Is it possible to make some inferences about how the urban space will be transformed when the vehicle supports fully autonomous driving and becomes shared and the total number of cars decreases as envisaged? How can a city built according to the demands of the past respond to the needs of the future? Can the urban space dominated by the automobile be restored to the citizens?

Autonomous vehicles that can be called to the feet of the individual via a mobile application downloaded from the application store to the mobile phone is not a very utopian dream. Many companies such as Uber are investing significant amounts in autonomous driving and shared mobility applications. How will the urban space be shaped when autonomous vehicles that leave their passengers at the location marked on the application and continue their activities to pick up another passenger after disembarking the passenger become an important part of daily mobility? As mentioned before, it is predicted that fewer cars will be needed as a result of the car's support for autonomous driving features and its shared use. When the car no longer belongs to the individual, that is, it becomes an element of the sharing economy, perhaps it will not feel the need to stop except for charging. In today's city, the areas reserved for car parking occupies a large area. Areas corresponding to 81% of the city's surface area in Los Angeles are used as parking lots. It corresponds to 76% in Melbourne, 57% in Houston, and 18% in London and New York.[2] Will we need that many parking lots when the vehicle becomes driverless and shared?

According to many studies, it is believed that an autonomous vehicle will offer a much more precise driving experience than a human-controlled car. A driverless vehicle, which moves by processing the data it receives from its surroundings and other vehicles, may lead to a decrease in the following distance in traffic, narrowing of lanes and a decrease in their number. In a city center where pedestrians are concentrated, it can stop by itself to give way to a pedestrian who wants the right of way, while remaining true to the borders

2. Hod Lipson and Melba Kurman, Driverless: Intelligent Cars and the Road Ahead Cambridge, MA: The MIT Press, 2017, 71-72.

drawn for it. The possibility of the disappearance of the pavements that draw sharp boundaries between the pedestrian and the car in the current era can only be realized if the vehicle adheres to the restrictions arranged for it. As a result, pedestrians who are confined to the pavement may have wider at-grade surfaces where they can move more freely. In other words, it may be possible to regain a significant part of the urban space dominated by the automobile to the citizens. Therefore, would it be correct to say that urban policies towards the pedestrianization of urban centers will become an idea that is more possible to be realized with autonomous vehicles?

The object of architectural practice is a physical space where we carry out our daily routines and reflect our cultural identity. However, the automobile is a space where we travel from point A to point B, which takes us into the public space, and where we usually spend limited time. The driver is required to follow the road while the passengers must sit in the direction of travel, making the comfort and ergonomics of the driver an important criterion in the interior design. However, with the advent of autonomous driving features in the near future, the driver and the steering wheel will be eliminated, leading to radical changes in the interior space of the car. If it is assumed that there will no longer be a need for someone to face the road and control the vehicle, the interior space can be organized in completely different ways. The driver is now part of a journey where they do not have to take responsibility like other passengers. Therefore, the time spent during the journey belongs entirely to the driver. In the past century, the car was considered an object that liberated people as it accelerated when the gas pedal was pressed. However, nowadays, the time spent in traffic during driving is perceived as time lost. Therefore, the aim is to convert the time lost during driving into time that the driver can use to carry out their daily routines. As a result, it is envisaged that the physical interior space of the car will change to allow for different daily routines of individuals. In a scenario where there is no steering wheel and the driver has the same status as the other passengers, can the interior of the car go beyond being an ordinary passenger cabin?

In the first part of the thesis, it is focused on how the emergence of new architectural typologies and infrastructural elements, with the emergence of the automobile after the industrial revolution, overturned the traditional city. It has been tried to examine how the urban space has become a topography consumed by automobiles. The debate has been advanced over the ideal modern cities that modernists such as Corbusier and Wright shaped

with the automobile. Afterwards, the avant-garde ideas that emerged in the 1960s against the overly organized and perfectionist cities produced by modernists were mentioned. Megastructure cities of Yona Friedman and Archigram have been opened to discussion. In the second part of the thesis, it is focused on the potential effects of electric and driverless vehicles and new mobility trends on urban space, which are expected to replace the traditional automobile. How electric and driverless vehicles, which will provide the mobility of the future, will transform the urban space, were discussed through projects, published articles about future mobility and current news. Concept projects depicting the city of the future contributed to the deepening of the subject. Based on the discussions, it was tried to find the answers to the aforementioned questions.

Throughout the research process, it has been focused on the question of how electric and smart cars, which will replace the traditional car, will affect the fate of the urban space. In this context, the ideal cities of the modernists, the megastructural cities that emerged in the 1960s and the imaginations of the cities of the future took place in the focus of the thesis. Discussions to find the answer to the question posed by the thesis were made with the help of various sources. Researches on future mobility, projects produced about the city of the future and current news are taken as reference. Inferences have been made on how societies' tendencies towards new trends will affect daily mobility. Discussions continued on the possible effects of the obtained data on urban life. Web sites such as Archdaily and Dezeen were used for the projects produced collectively by architects and automobile companies on the city of the future. Along with the project texts, perspective images and videos, the potential effects of the vehicles of the future on the city have been tried to be examined. Articles written by respected newspapers such as the Guardian, BBC and CNN on urban policies, the automobile of the future and developments in the industry also contributed to the deepening of the discussion.

The Collapse of The Traditional City

01

1.1. Birth of the Modern City

The automobile, which emerged as one of the most important inventions of the Industrial Revolution, has always been in direct relation with urban space since its existence. The emergence of self-powered vehicles in the last decade of the 19th century on city streets in Europe and America forced architects and planners to rethink the built environment. The automobile has created a provocative environment for architects to reflect on the current urban form and the new requirements of the Industrial age. The concept of speed has become a dominant factor, consequently transforming the city and social life. The automobile took an active role in the city and became an infrastructural element, so the pattern of the city began to change and its periphery began to expand. The highways designed for automobiles around high-rise buildings by famous and modernist architects of the period (such as Corbusier and Wright) represent the characteristic texture of the modern city. Of course, this radical change has opened the daily life practices of human beings to question again; habits of existence, accommodation and working have also begun to change as a result of the speed-oriented transformation.

Approximately 100 years ago, the concept of mobility changed with the inclusion of the automobile in daily life. As a result of the increased mobility of human beings, cities started to change their crust. The city, which was shaped according to the distance covered by a 5 km walk and a horse carriage before the 1880s, spread to a 20 km circumference with the streetcar in the 1920s. With the inclusion of the automobile in the city, the city has shown a great development and reached 60 km perimeter, which is determined as 1 hour driving distance (Figure 2).[3]

The spread of cities into wider areas did not happen all at once, of course. After the industrial revolution, the impact of industrialization in cities created a serious need for labor. With the decline of agricultural activities in rural areas, a heavy migration towards cities began. The significant increase in population as a result of migration to cities led to the growth and expansion

3. "Evolution of Transportation and Urban Form in North America and Europe," The Geography of Transport Systems, Last modified October 1, 2022, https://transportgeography.org/contents/chapter8/transportation-urban-form/evolution-transport-urban-form/.

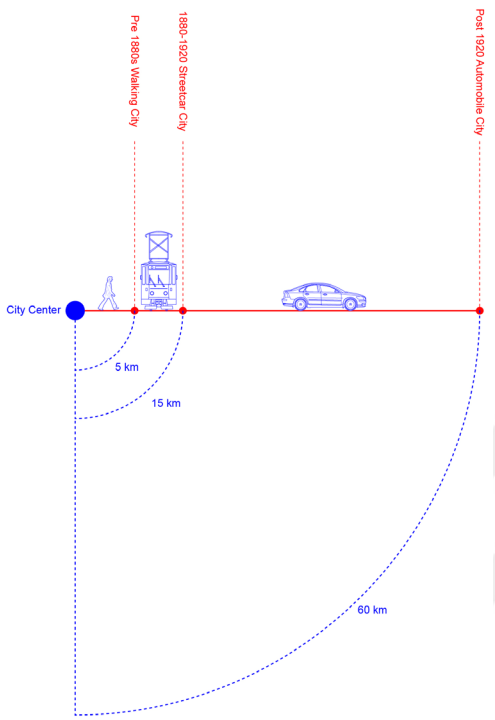


Figure 2: Expanding of Cities

of cities. The automobile industry was one of the most important factors in the growth of urban populations. Detroit, home to automobile giants like Ford and General Motors, experienced one of the biggest migrations in history. While only 3,000 people worked in the automobile industry in 1904, the workforce in the automobile sector in Detroit alone had reached 75,000 after 15 years.[4] The automobile not only contributed to the growth of cities through the freedom of movement it provided to individuals, but also led to the increase in the economic market, population growth, and thus, the expansion of cities and population into wider areas. In the 20th century, Detroit led the American economy. The economic volume created by large automobile factories led to Detroit becoming the third most populous city in the United States, and its city limits expanded from 60km² to 360km².[5]

With the expansion of the city, access to suburban settlements on the city periphery was provided by rail systems or cars. The automobile was one of the most important actors in the spread and growth of cities into wider areas. Because it allowed individuals to travel independently, it encouraged the production of highways that connected different points within the city. It reduced people's dependence on public transportation with fixed routes and provided them with an area where they could travel freely. The American city first began to grow after the construction of interstate highways funded by the state in 1956, following World War II. In 1940, only one out of every five people owned a car.[6] Today, car ownership and dependence have almost balanced with the population. As car ownership and dependence increased, more highways were built. The combination of the automobile and highways was enough to break up the traditional limits of the pre-automobile city.

In America, it was the biggest desire of many individuals to own a house with a garden on the outskirts of the city. For Americans who were uncomfortable with the influx of new immigrants from the South and Europe into the city and therefore wanted to live away from the economic activity in the city center, living in nature was a good idea. Rows of two-story detached family houses lined up with a garden in front of a winding road where one could park their car, defined the typical suburban settlement of the American city (Figure 3). It was an absolute necessity to own a car to be able to live in these houses. Individuals generally needed a car to go to their job in the city center and to meet their basic needs. For example, living in a city spread over a very large area, such as Los Angeles, where traveling from one place to another took a long time, was quite difficult without owning a car. In Texas, it

4. Joe Kerr, "Trouble in Motor City," essay, in Autopia: Cars and Culture, ed. Peter Wollen and Joe Kerr London: Reaktion Books, 2002, 127.

5. Ibid.

6. Peter G. Rowe, Making a Middle Landscape Cambridge, MA: The MIT Press, 1991.

was common for city dwellers to travel 100 miles to eat at any restaurant.[7] Therefore, dependence on cars was inevitable. Mass transportation was not sufficiently developed to meet the intense transportation needs within the city either. Huge investments were required for the mass transportation system, but the process was quite long, difficult and political. Public transportation initiatives in cities spread over very large areas such as Los Angeles, Dallas, Houston, and Denver usually ended in failure due to the population being scattered and randomly distributed and irregular travel habits.[8] The traffic and parking problems created by individuals who came to the city center by car every day to go to work from their suburban homes had become an inevitable consequence.

Figure 3: Typical detached suburban houses with garage and garden lined up one after the other in Levittown (Source: Bettman Archive)

Wealthy individuals who dreamt of living a life away from the problems of the city and owning a spacious suburban home significantly impacted the fate of the city. As the wide and expansive highways began to shape the city, deep divisions emerged. City centers were generally abandoned to neglect and poverty, resulting in an increase in crime and deepening problems, transforming into areas of increasing difficulty. The dense and high-rise structures in city centers, wide avenues and highways that disrupted pedestrian flow, heavy traffic created by cars, and the insufficiency of parking areas for vehicles were some of the fundamental problems. The narrow and

7. Donald Richie, "Some Thoughts on Car Culture in Japan ," essay, in Autopia: Cars and Culture, ed. Peter Wollen and Joe Kerr London: Reaktion Books, 2002, 142.

8. Moshe Safdie and Wendy Kohn, The City after the Automobile: An Architect's Visión Boulder, CO: Westview, 1998, 7.

crowded streets of the traditional city before the age of the automobile were not equipped to meet the growing traffic and parking needs. The old cities needed to adapt their city centers to accommodate cars, but at the time of their establishment, the automobile and the traffic it would create were not anticipated. Creating wide avenues that allow cars to move, directing pedestrian circulation in a way that does not affect vehicle traffic, having main traffic arteries pass through adjacent neighborhoods or directly dividing a neighborhood, and converting old public buildings into parking lots were some of the methods used to address this situation. City centers became a space where individuals who lived in suburban areas could continue their jobs and where commercial and cultural activities continued. Not all of the settled population lived in the suburbs on the outskirts of the city. Medium and high-density residential complexes emerged for individuals living in city centers. The automobile not only transformed the old city center but almost overthrew it.

As the city continued to grow, it seemed inevitable that all actions carried out by humans would be shaped through automobiles. The dynamism of the old city center, which was dependent on human density, was gradually disappearing. Individuals were making themselves present in public spaces by sitting in their cars, feeling safe and secure. The fundamental criterion in the construction of many modern cities was the consideration of individuals as driver-citizens, which demonstrated how dominant a role the car played in the production of urban spaces.[9]

Every action in the construction of a modern city was designed with the goal of being accessible by car. Even the basic activity of shopping had completely transformed. The traditional, local, and small shops that were once in the city square and nourished by dynamic pedestrian circulation began to close one by one. Car usage widened the range of options available to humans. Shopping centers emerged with high numbers of parking spaces that were easily accessible by car at the intersection of two main arterials on the edge of the highways. They became an attraction point in faraway, cheaper lands from the city center. Giant companies like Montgomery Ward and Sears Roebuck, which used to sell mail-order homes, began to close their small, traditional stores in the city center and open large stores on the edge or intersection of the highways. In his famous book, “Automobile Age,” James J. Flink refers to Robert E. Wood, the vice president of Sears, who stated:

9. Taylan Özgür Polat, “In Between Automobility and the City” thesis, ITU, Institute Science and Technology, 2002, 19.

> "When automobile reached the masses it changed this condition and made shopping mobile. In great cities Sears are located its stores well outside the main shopping dist ricts, on cheap land usually on arterial highways, with ample parking space."[10]

The traces of the urban revolution created by automobiles were not limited to high-rise buildings, shopping centers, and wide highways. As the city grew and expanded, the active role of the automobile in everyday life changed routines and habits and led to the emergence of new building typologies, as well as the disappearance of some concepts that formed the traditional city. Before the automobile, the city center was a recreational public space where individuals with different cultural backgrounds gathered, exchanged ideas, conducted commercial activities, participated in cultural activities, and sometimes performed their worship, and pedestrian circulation flowed smoothly. However, the old city center was nothing more than a transit space that was passed through by the automobile, which had a speed capacity far beyond that of human beings. Le Corbusier, one of the most important representatives of modernism, argued that the old city center needed to be demolished because it did not meet contemporary needs and because automobile circulation was not possible:

> "The big city is a trap, cars are rabbits. So the trap should be eliminated, that is, the old cities should be demolished. The old city that will be demolished will give way to a contemporary city where rabbits can roam freely. Where to start the demolition? Again, cars show the way: Where are the cars going? To the center. There is no space to circulate in the center. We need to create space to circulate We need to demolish the center."[11]

Corbusier's foresight was not a utopian approach. In the book "Middletown in Transition," published in 1937, it is vividly described how the automobile took over public space: Streets, where children used to play freely, are now under the control of the automobile.[12]

As a result of the fragmentation of public space with the dominance of automobiles, individuals have begun to feel alienated within the city. They struggle to feel free within public spaces. The automobile itself appears to be a machine that restores individual freedom and carries them into public

10. James J. Flink, The Automobile Age Cambridge, MA: MIT Press, 1990, 154-155.

11. Aykut Köksal, "Le Corbusier: 'Otomobil Büyük Kenti Kurtarmalı.,'" Arredamento Mimarlık, 2001, 61–62.

12. Robert S. Lynd and Helen M. Lynd, Middletown in Transition: A Study in Cultural Conflicts New York, NY: Harcourt, Brace and Company, 1937.

space. The concept of the city is a complex structure created by people with different pasts and cultural accumulations. It exists on top of the identity gained with its past, with the effect of the layers added in different periods. However, political and economic developments in the world after the Industrial Revolution have led to the inevitable transformation of many cities. The dramatic growth of the city, which changed its demographic structure with the Industrial Revolution, along with the revolution created by the automobile in urban transportation and the great destruction caused by World War II, played a decisive role in the transformation of cities. Many famous modernists of the period also put forth deep discussions on how the modern city should be, as they believed that the traditional city could not meet the contemporary needs of the day.

1.2. Ideal Cities

The automobile had become such a powerful figure that it was one of the most decisive figures in the production of urban space. North America's urbanization model was a pioneering model for the rest of the world because it was the first geography where the car met urban space and the urban population on a mass scale. In the Far East, Europe, the Soviet Union, and many other places, the most important question was how the car, which had become an undisputed figure of everyday life, would find its place in urban space. Important figures of the 20th century were closely interested in how the post-car city should be. They thought extensively about how the car would play a role in the city and how it should transform the city. According to many common opinions, the city should be a space where traffic flow can be ensured, and cars can move easily; the dynamism of the car should determine the fate of the city.

Le Corbusier, who planned to rebuild the city center of Paris, introduced a groundbreaking urban design concept called Plan Voisin in the early 20th century. The concept was based on the idea of creating a new urban environment that would be more efficient, livable, and beautiful than traditional cities of the past. More importantly, it clearly showed that the automobile played a decisive role in the design of urban space. For the city plan designed to rebuild the center of Paris, Corbusier met with the most powerful French automobile companies of the time, Citroen, Peugeot and Voisin.[13] It is not surprising that the automobile industry, which wanted to

13. Engin Tulay, "Mimarlık ve Otomobil 'Sınırları Her an Değişen Mekan'" thesis, İTÜ Fen Bil. Enstitüsü, 2003, 49.

have a say in the production of urban space, had the sole goal of increasing automobile sales, which could encourage the production of highways through a mutualistic relationship. Although Plan Voisin remained only an ideal on paper and was never implemented, it was considered a role model in the construction of new cities after World War II.

After the failures of the Ville Contemporaine and Plan Voisin projects, Corbusier worked on a new vision of the city he named Radiant City. Corbusier argued that many historic cities were inadequate in meeting contemporary needs, and that modern cities should consist of wide roads that allow for easy movement of cars, high-density apartment buildings, high-rise office towers for technocrats, and industrial and dynamic suburbs with strong connections. He attempted to erase the shortcomings and problems of the old, traditional and compact city with the density provided by skyscrapers and grid-like roads that allow for easy movement of vehicles.[14] He envisioned a city made up of high-rise towers within equally sized building blocks that intersected at right angles in a grid-like pattern (Figure 4). According to Corbusier, geometry and symmetry were very important because they facilitated standardization.[15] Radiant City was conceived as a large-scale, modernist city characterized by tall, elegant buildings, wide boulevards, and open green spaces. The city was designed to be extremely functional, with separate areas for living, working, and leisure activities. The goal was to create a city that was both efficient and beautiful, with a strong emphasis on modern aesthetics and functionality.

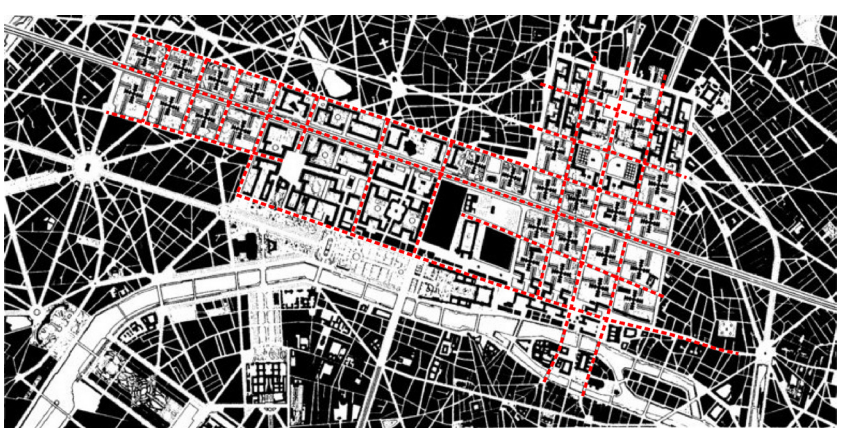


Figure 4: Radiant City and its Gridal Plan Scheme (Source: Tomorrow City)

Radiant City was planned as a city with a grid-like planning scheme, designed to accommodate three million people and conform to Corbusier's definition of a modern city.[16] According to Corbusier, the city should be strictly divided into commercial centers, business centers, residential areas, and

14. Safdie and Kohn, The City After The Automobile, 16.

15. Gili Merin. "AD Classics: Ville Radieuse / Le Corbusier." ArchDaily. Last modified August 11, 2013. https://www.archdaily.com/411878/ad-classics-ville-radieuse-le-corbusier.

16. Le Corbusier, The City of To-Morrow and Its Planning, trans. Frederick Etchells Cambridge, MA: The MIT Press, 1972, 368.

17. Merin, "Ville Radieuse"

entertainment districts. The business district was located in the center of the city and consisted of skyscrapers, each 200 meters tall and capable of providing employment for up to eight hundred thousand people. The residential area was located around the edge of the business district. The prefabricated apartment blocks, called "Unités," were designed to house approximately 2,700 people and reach a height of around 50 meters (Figure 5). These blocks were intended to be social housing, allowing residents to engage in various social activities in addition to meeting their basic needs.[17] Citizens who wanted to commute from the residential area to their jobs in the business district had to either use their own cars or the advanced underground train system designed between the two areas.

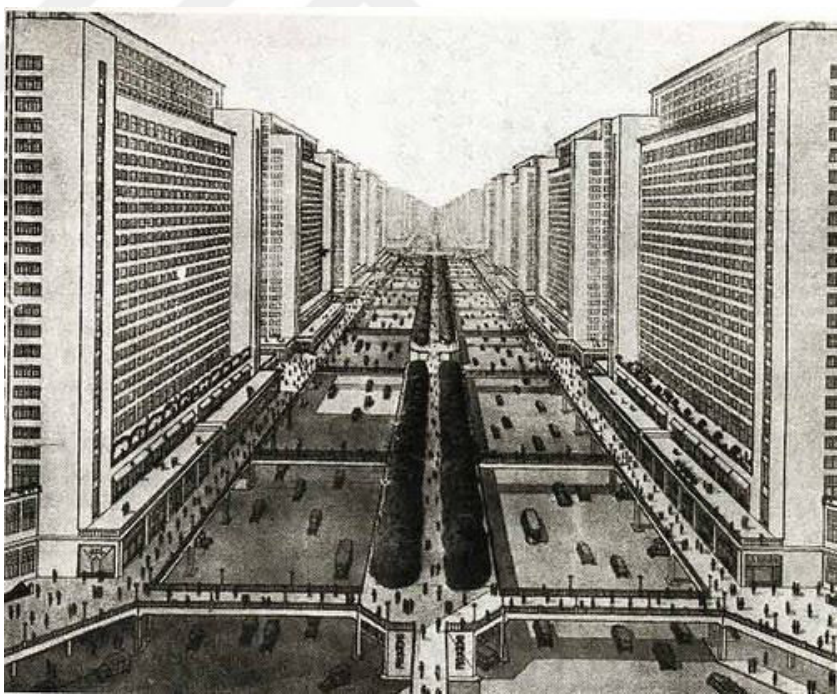


Figure 5: A perspective from Unités (Source: iamyouasheisme.wordpress.com)

Frank Lloyd Wright and Ebenezer Howard proposed self-sufficient settlements spread out over wider areas, creating their own density, in contrast to Corbusier's idea of a high-density urban center. With the rapidly increasing population of the city, which became attractive after the Industrial Revolution, problems were inevitable as it began to grow unplanned. Rural areas promised a desirable life close to nature, but suffered from being far from the economic heart of the center and being isolated. The city's planning around a single center and the uneven distribution of population density

throughout the city were the root of the problems. Wright and Howard believed that a non-centralized planning approach could overcome these issues.

In order to eliminate the segregation between rural and urban areas and prevent the unplanned growth of cities by utilizing the advantages of both, garden cities emerged in the late 19th century. The famous "Garden City" announced by Ebenezer Howard in 1898 was one of the pioneers of this concept.[18] In the low-density Garden City with a circular planning model, the houses were lined up one after the other on the periphery, while a garden was located in the center of the houses. Outside the circle, there were lands where residents could farm.[19] Ebenezer Howard used a triple magnet diagram to summarize the ideas of garden cities. The first magnet lists the disadvantages of the city center, the second magnet lists the disadvantages of the countryside, and the third magnet brings together the advantages of both the countryside and the center (Figure 6).

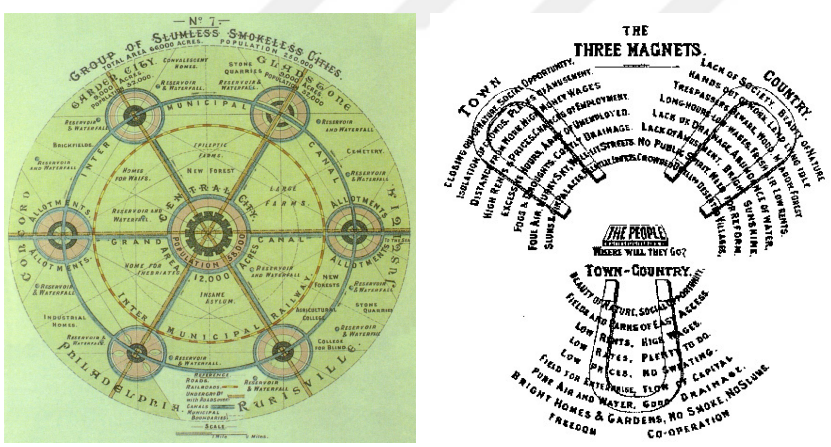


Figure 6: On the left is the schematic plan of the Garden City; on the right, Howard's three magnets diagram (Source: Archdaily)

Wright opposed the idea of dense cities, advocating for a decentralized approach similar to Howard's. His city model, called "Broadacre" in 1935, was a homogeneous city with density dispersed across large areas. It consisted of numerous commercial areas, each with various scales, housing both residential settlements and commercial zones. Each zone was considered relatively autonomous and independent while creating its own density.[20] Like Corbusier's city, high-rise buildings were also important components of Wright's city. However, these tall buildings were not concentrated in a designated area within the city; instead, they were scattered throughout the city, serving as landmarks for each zone (Figure 7).

18. Susanna Moreira, "What Are Garden Cities?," trans. Tarsila Duduch, ArchDaily, Last modified May 12, 2021, https://www.archdaily.com/961275/what-are-garden-cities.

19. Safdie and Kohn, The City After The Automobile, 14.

20. Ibid.

21. Jennifer Gray, "Reading Broadacre," Frank Lloyd Wright Foundation, Last modified October 1, 2018, https://franklloydwright.org/reading-broadacre/.

Figure 7: A perspective from Wright's Broadacre City (Source: Frank Lloyd Wright Foundation)

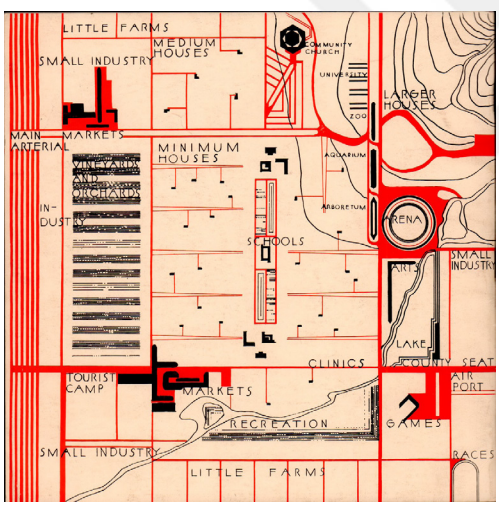


Figure 8: Plan of Broadacre (Source: Frank Lloyd Wright Foundation)

Broadacre was originally a typical rural and decentralized city model, funded by Rockefeller during the Great Depression, intended to inform the public about developments in the American industry, with an area of 10.36km², planned to be home to 1,400 families.[21] There were units in the city that could meet all the needs of modern society: farms, factories, offices, schools, parks, places of worship, houses of different scales, recreation areas, government center, airport…(Figure 8) According to Wright, everyone in Broadacre should own a car. Multi-lane highways would make traveling fun and safe. In addition, the road system and structures are arranged in such a way that they do not hinder the visibility of any traffic signs. According to Wright's foresight, Broadacre was a city that would house 7,000 people; but this was no more than a prediction. He did not anticipate that the population in the city would drive hundreds of kilometers every day to travel to work, school, hospital, cultural activities, shopping and more, and the population of the region would reach approximately 10 million.[22]

1.3. Disruptive Ideas

Against the perfectionist, monotonous and overly functional cities of the modernists that serve the capitalist order, new urban ideas were put forward by architects who challenged the principles of modernism in the 1960s. They discussed the concepts of form and functionality introduced by modernism, and even architecture as a discipline. They aimed to free the individual from the monotonous living and working areas by putting forward anti-establishment projects against the spatial and social shaping of the individual and his separation from social life. In this context, mobility has been considered as an important concept on the way to liberating the individual. They argued that the demolition and reconstruction of the traditional city was not necessary, but that it could be built on top of the existing one. They believed that the city should be built collectively, without being bound by certain functions and forms. In this context, the architect had to offer only an infrastructure. The units that make up the city would be like an organism established by being articulated to this infrastructure.

The idea that the basic element that constitutes the urban space is an infrastructure established by the architect and that the city should be transformed into a collective form by being articulated to this infrastructure was first put forward by Yona Friedman. According to Friedman, what brought

22. Safdie and Kohn, The City After The Automobile, 15.

the urban space into existence and gave it identity was its inhabitants. Vladimir Belogolovsky, in an interview with Friedman, he contributes his ideas by citing Friedman's words: "An architect does not create a city, only an accumulation of objects. It is the inhabitant who 'invents' the city; an uninhabited city, even if new, is only a 'ruin.'"[23] Friedman promised an elevated city where residents could carry out their daily routines in self-designed residences and workspaces. He was explaining with various illustrations that the elevated city would remain within the boundaries of the existing city and would be built on top of the old city without the need to demolish it (fig. 9). Thus, he suggested that the growth of the city would be possible without spreading to wider areas.[24]

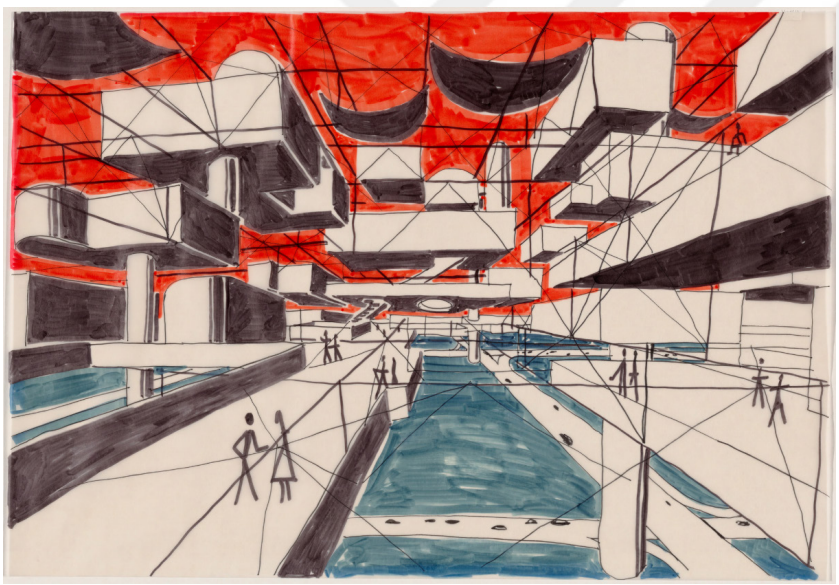


Figure 9: An illustration of Yona Friedman's Spatial City (Source: MoMA)

The city, which Friedman named "Spatial City", consists of a space frame structure placed on columns arranged at intervals of 40-60 meters and a 6x6 meter grid floor. All kinds of working and accommodation spaces can be placed inside the grill. Some of the grids will also be left empty, allowing natural light to reach the lower elevations and the ground.[25] Beneath the elevated city, the present city would continue to exist. As understood from Friedman's illustrations, urban transportation would be provided by cars (Figure 10). Friedman was not responsible for the construction of the city. After providing the legitimate infrastructure, the choice of the units to be settled was left to the residents of the city. The user would decide how the living units would look. Friedman argues that each person is different and

23. Vladimir Belogolovsky, "Interview with Yona Friedman: 'imagine, Having Improvised Volumes "floating" in Space, like Balloons,'" ArchDaily, Last modified February 24, 2020, https://www.archdaily.com/781065/interview-with-yona-friedman-imagine-having-improvised-volumes-floating-in-space-like-balloons.

24. "Spatial City," Architectuul, accessed May 25, 2023, https://architectuul.com/architecture/spatial-city.

25. Ibid.

26. Belogolovsky, "Interview with Yona Friedman."

shapes the volume in which they spend their daily time based on their own desires. He exemplifies this idea over a high-rise tower. In a tower structure, each floor of which has the same spatial volume, the user decorates the interior space where he spends his time, together with the furniture, according to his own wishes.[26] For this reason, nothing was fixed and certain in the urban space, except the main structure. The city had to develop in a haphazard fashion, with trial and error.

Figure 10: A collage of the Spatial City on the Champ Elysees in downtown Paris (Source: Yona Friedman)

Influenced by the ideas of Yona Friedman, Archigram, one of the British avant-garde and collective architecture groups of the 1960s, including Peter Cook and Michael Webb, produced more than 900 speculative drawings on urban space, even though they were never built.[27] Introduced by Peter Cook in 1964, the Plug-in City was created by manipulating the perception created by the conventional infrastructural elements that make up the urban space. The Plug-in City was more than an idea put forward with the promise of being a new city instead of an existing city, it was a mega structure that was constantly developing and growing, housing the transportation network, residences and all other basic services. Simon Sadler, in his book "Archigram: Architecture without Architects", stated that Peter Cook was influenced by the powerful megastructures of modernism when designing the Plug-in City, such as Unite d'Habitation designed by Corbusier and Karl-Marx-Hof designed by Karl Ehn. The principles of collective living, variable housing units and accessible transportation networks provided by these structures formed the

26. Belogolovsky, "Interview with Yona Friedman."

27. Gili Merin, "Ad Classics: The Plug-In City / Peter Cook, Archigram," ArchDaily, Last modified July 10, 2013, https://www.archdaily.com/399329/ad-classics-the-plug-in-city-peter-cook-archigram.

28. Simon Sadler, Archigram: Architecture without Architecture Cambridge, MA: The MIT Press, 2005, 14.

basis of Cook's design. He also stated that the sense of incompleteness in the Plug-in City was a reference to the construction boom in London in the 1960s.[28]

The Plug-in City consisted of a mega-structural frame created by diagonally interconnected 3-axis pipes, modular units that can be attached and detached from the structural frame, and gigantic cranes. Together with the monorail network and cranes installed, it consisted of modules that could be replaced as units to be fitted into the structural framework became obsolete or outdated. For example, 3 years for bathroom, kitchen and living room units, 5 years for living room and bedrooms, 15 years for the location of residential units, 4 years for workplaces, 20 years for car silos and roads, and 40 years for megastructure were defined as the ideal period (Figure 11).[29] While transportation was largely provided by monorail networks, the automobile was not taken into the background. Highways created at different elevations and car park silos of various scales served the automobile (Figure 12). When Cook's drawings are examined, the combination of residential units, commercial units, various socio-cultural volumes and service units that make up the urban space is striking. Housing units, office settlements, schools and socio-cultural units that create the urban space in Corbusier's Radiant City are clustered at different points of the city. Each region is monotonous in itself. However, in the Plug-in City, the combination of units belonging to different characters that create the urban space, the gigantic structure that holds the city, and the gigantic cranes connected to the structure that makes the change promise to break the monotony of the city and give it a dynamism.

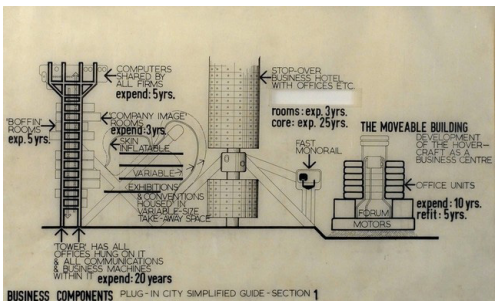


Figure 11: Optimal Replacement times of modules in the Plug-in City (Source: MoMA)

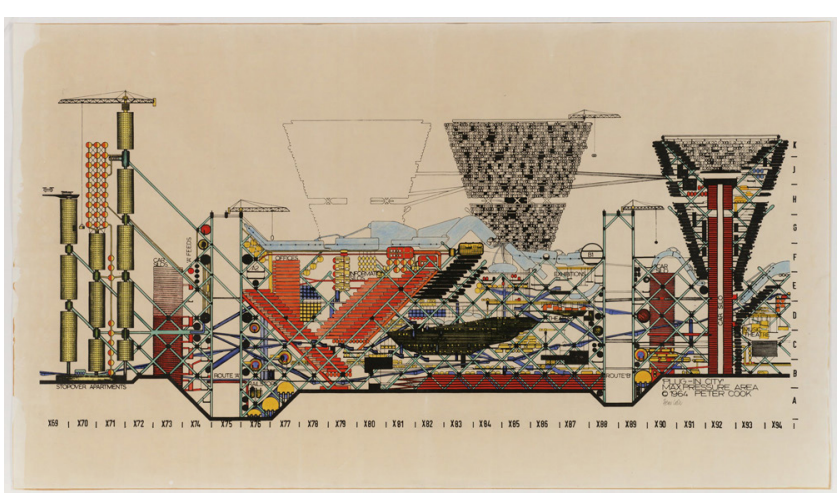


Figure 12: A section of Plug-in City (Source: MoMA)

29. "Archigram #3: Plug-in City," Arkitektuel, Last modified July 16, 2020, https://www.arkitektuel.com/plug-in-city/.

Mobility was a very important concept in both Friedman's Spatial City and Archigram's Plug-in City. However, mobility was defined not by the movement of the car, as in Corbusier or Wright's city, but by variable modules that could be attached and removed from the structure. What gave the individual his/her mobility was that the units were interchangeable at will. In addition, modules could be moved to another location at any time. In both cities, the automobile was responsible for urban transport; however, it did not have a decisive character in the construction of the city. The most decisive criterion in the construction of the city was the users themselves. The inhabitants of the city had to determine the production of the city they were in, by articulating with the legitimate infrastructure provided by the architect.

Until the 1960s, European cities were inspired by American cities shaped around the automobile. European cities have also been rebuilt after automobiles, just like American cities; it had become campuses where suburbs expanded and parking and traffic problems arose. Even the trams, which significantly supported the mobility in the city center, were dismantled for the movement of the cars. However, towards the end of the 1960s, many European cities promoted walking, cycling and public transport; began to focus on policies that restrict driving. Urban centers were tried to be freed from vehicle traffic. Along with the extensive tram networks, people started to move easily from one place to another in the city centers where the automobile could not reach. In the last two decades, the situation in the American city has begun to change. American urban planners began to look at European cities in the face of the transportation system, which was becoming inextricable with each passing day. In addition to the urban planning policies that put pedestrians and cyclists at the forefront, the mobility understanding of societies is also being radically transformed. A future where individuals need less to buy cars, do not have to control the car, and share their journey does not seem far away. What kind of city awaits us in the near future, where the concept of mobility is completely reconsidered?

The Future of Cities

02

Cities continue to grow; a new megacity is added to others every day. As the population continues to grow, resources are quickly depleting, but the needs of city dwellers continue to increase. Traffic continues to increase exponentially every day. Intense traffic causes serious noise and air pollution within the city. Traffic accidents can occur in the chaotic environment created by congestion. The resulting costs put an extra burden on the individual. A person who leaves for work in a megacity has to spend at least an hour in traffic. They struggle to find a parking spot for their car at the end of the journey. This situation not only causes the individual to lose time, but also causes psychological exhaustion. Considering all of this, the automobile, which was thought to give freedom to the individual according to the mindset of the previous century, is turning into a torture machine that condemns the individual to stress. Therefore, in our age, individuals are showing a tendency towards more sustainable alternative transportation methods.

Especially after the Covid-19 epidemic, which emerged in Wuhan, China in 2019 and affected the whole world, a certain part of the working population started to work from home. Thanks to developing technology, many basic needs can now be requested through mobile smart devices that individuals own. Many services provide service right to the individual's doorstep through mobile applications downloaded from app stores on their phones. Various mobility services such as car-sharing applications, taxi calling applications, and shared e-scooter applications are among the leading services. Even an individual's daily mobility is now shaped through their mobile phones. They check the status of the road, select the most suitable route, and make a budget-friendly choice before they even leave home.

Stephen Moss, in his article in the Guardian, refers to the statement of Gilles Vesco, responsible for sustainable transport policies in Lyon: "Some transport sociologists say that information about mobility is 50% of mobility. The car will become an accessory to the smartphone."[30] According to many studies, the young generation under the age of 40, who make up the majority of the working population, have a tendency to own less compared to the previous generation. Joe Cortright's research shows that Generation Y are 29% less likely to own a car than the previous generation. (Figure 13).[31] Parking

30. Stephen Moss, "End of the Car Age: How Cities Are Outgrowing the Automobile," The Guardian, Last modified April 28, 2015, https://www.theguardian.com/cities/2015/apr/28/end-of-the-car-age-how-cities-outgrew-the-automobile.

31. Joe Cortright, "Young People Are Buying Fewer Cars," City Observatory, Last modified April 22, 2015, https://cityobservatory.org/young-people-are-buying-fewer-cars/.

problems, constantly emerging maintenance costs, taxes, and intense traffic are turning individuals away from owning a car. Furthermore, except for a one-hour drive, a parked and idle vehicle for a significant portion of the day is seen as an unnecessary expense. For this reason, in cities where public transportation has developed, the dependence of individuals on cars to go from point A to point B is decreasing. At the same time, the widespread use of shared vehicle applications, which have become quite popular recently, helps to alleviate the burden on the city. While a personally owned vehicle serves only one household, shared vehicle applications can serve approximately 60 people.[32]

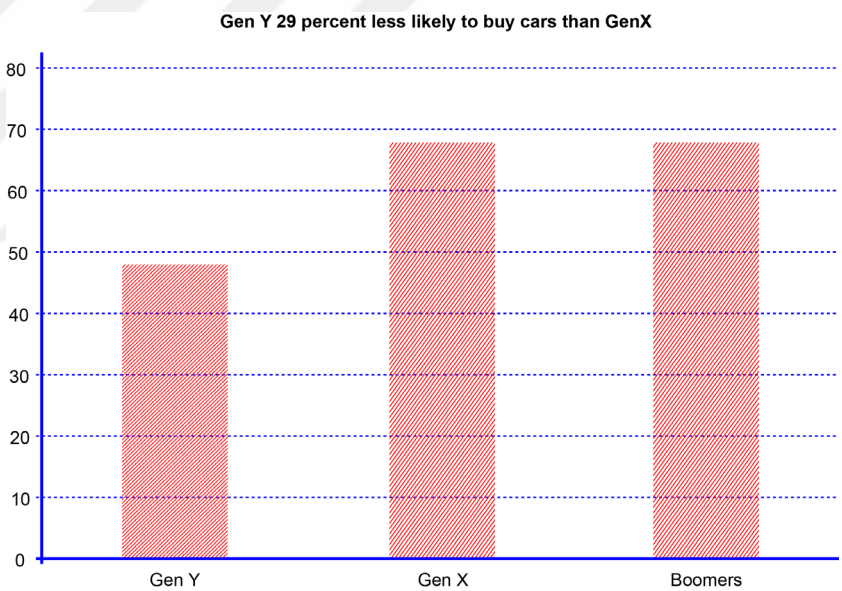


Figure 13: Vehicle ownership rates by generation per 1000 people (Source: City Observatory)

The fact that technology has reached a very advanced level, the new habits, tendencies and preferences of societies, and the rapid depletion of resources as a result of the incredible increase in the world population play an important role in the change of the automobile industry. The automobile industry is undergoing perhaps the greatest transformation in its relatively short history. Electric vehicles are taking the place of fossil fuel vehicles with high carbon emissions. Electricity, a cleaner energy source, is becoming the fuel source of new-generation cars. Electric cars with low carbon emissions, no exhaust and no engine noise are becoming more and more common in everyday life. According to the Paris Agreement signed in 2015 on climate change mitigation, adaptation and financing; The Netherlands will eliminate fossil fuel vehicles by 2025, India and Norway by 2030, and the UK and France

32. Moss, "End of the car age."

by 2040.[33] Charging stations will take over the gas stations on the highways where thousands of vehicles enter and exit every day to fill their tanks. We have already started to see many charging units in the parking lots, on the sidewalks where cars can park in the urban space.

The driver, who loses time behind the wheel and gets stressed during the day, is gradually taking over the place of artificial intelligence. Thanks to various driving assistants equipped with advanced sensors - such as collision prevention, lane tracking, parking, semi-autonomous driving assistants - possible accidents are tried to be prevented and the responsibilities of the driver are reduced. In the very near future, it is aimed that the car will become completely independent from the driver and the steering will be completely eliminated. How will the city be affected when the steering wheel is removed and the driver is in the same status as the other passengers? What will change when the autonomous car, which can unload its passengers and continue its activities, can park itself? Beyond that, the driverless vehicle, which has become an element of the sharing economy that no longer belongs to the individual. What kind of a transformation will it lead to in the urban space when it starts to serve many individuals and does not need to stop except to recharge? What will happen to the parking lots that occupy a significant area in the urban space?

According to many new city visions, car-free city centers are one of the main goals. As in the pre-automobile era, city centers are desired to be turned into places where pedestrian interaction is intense, closed to traffic or restricted. Automobiles, which were almost seen as superheroes in the post-automobile era, are now seen as blood clots blocking the roads, which we can call the veins of the city. Heavy traffic, parking problems, air and noise pollution are among the main reasons for these problems. As a method to combat these problems; While intensive studies continue on alternative transportation methods, local governments continue to work on policies that will restrict or limit vehicle traffic. Incentives are given for the use of shared and electric vehicles. Vehicle roads are narrowed, sidewalks are widened. The use of bicycles and e-scooters is encouraged for short-distance journeys. While the parking lots are removed, public green spaces are built in their place where pedestrians can gather, walk, rest and breathe.

The local government in Lyon follows a policy of purging the city center of cars and transforming it into a human-oriented space, while providing incentives for shared mobility applications. Within a short period of

33. Danielle Muoio, "These Countries Are Banning Gas-Powered Vehicles by 2040," Business Insider, Last modified October 23, 2017, https://www.businessinsider.com/countries-banning-gas-cars-2017-10.

10 years, they have observed a 20% decrease in the number of cars entering the city center, and they expect a further 20% decrease in the next decade. Likewise, in London, a city where cars do not dominate compared to other European cities, the traffic in the city center has decreased by 30% since the 2000s, with the incentives given to alternative transportation methods and the restriction of private vehicles in traffic.[34] Barcelona, which has a very homogeneous and gridal urban planning, is working on a radical urban vision such as controlling traffic, eliminating vehicles from public space, and encouraging walking and cycling. They are redesigning settlement areas called "Superblock", or "Superille" in the Catalan language, which consist of 9 almost equivalent building blocks coming together to form an area slightly smaller than a neighborhood, measuring 400 by 400 meters and restricted to vehicle traffic. The inner roads separating the 9 building blocks in the Superblock are considered as pedestrian-oriented and green streets, which are only allowed at 10km/h, suitable for one-way movement for motor vehicles. The roads surrounding the Superblock are external roads that allow the passing of public transport and individual vehicles (Figure. 14).[35]

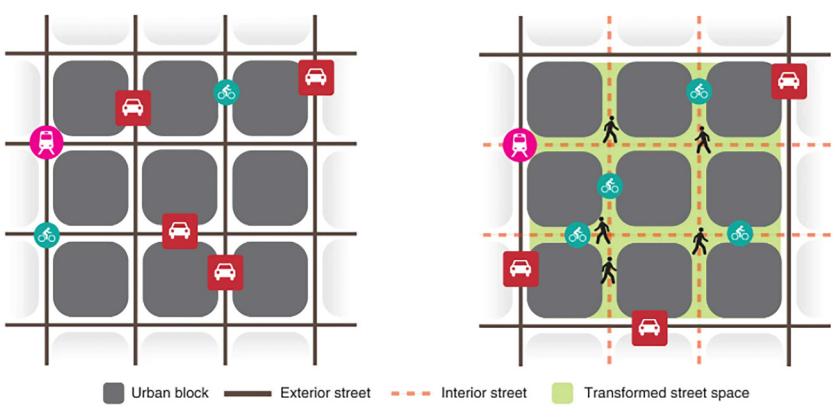


Figure 14: The Superblock Model (Source: Empa)

Considering the great technological advances in the automobile industry, new mobility trends and preferences of societies, and new city visions where the pedestrian is the main focus, there are many remarkable studies on how the urban space of the future will be. They continue discussions in the context of how it will create reflections in the city of the future, through deep researches and studies on how the car of the future should be. The future, where we will see cars flying in New York skies like in Luc Besson's 1997 movie "The Fifth Element", or self-driving cars that bring pizza to our feet like in the dystopian science fiction series "Black Mirror", is not far away (Figure 15).

34. Moss, "End of the car age."

35. Ronika Postaria, "Superblock (Superilla) Barcelona—a City Redefined.," Cities Forum, Last modified May 31, 2021, https://www.citiesforum.org/news/superblock-superilla-barcelona-a-city-redefined/.

It seems that self-driving cars equipped with superior artificial intelligence and capable of assuming human responsibilities will soon become important parts of everyday life and urban space. Robo taxis, which individuals call to their feet with the help of the mobile app on their mobile phones, will be an important part of urban mobility. The individual, who does not have to assume the control of the vehicle during the journey, will have time to spare for himself. With the disappearance of the steering wheel, the car will turn into mobile spaces that are shaped according to various functions and go on its wheels. In addition to driverless vehicles, drone-like flying cars seem to play an important role in urban transportation. Giants in the automobile, aviation and transportation sectors such as Uber, Hyundai, Audi and Airbus are making large investments in flying vehicles that are expected to play a role in urban transportation. In Turkey, remarkable studies continue with flying cars. In addition to Baykar's flying car called "Cezeri", the team led by MEF University faculty member Kürşad Özdemir continues to work on the autonomous flying car called "Kumru". Claiming that we will start seeing flying cars in the city sky by 2030, Özdemir states that by 2023, he aims to build a flying prototype of Kumru (Figure 16).[36]

Figure 15: Above is a scene from Black Mirror's episode "Crocodile", below is Luc Besson's dystopian New York (Source: Netflix and The Fifth Element Movie)

Figure 16: An image of Kürşad Özdemir and his team's flying car named "Kumru" (Source: Haber Aero)

According to Safdie, the transformation of the city over the past years has always been related to transportation revolution: the invention of electric trams revealing early suburban towns, the invention of elevators paving the way for the construction of high-rise buildings, and the inclusion of cars in everyday urban life breaking the traditional city boundaries and allowing for spreading into wider areas.[37] How will electric and driverless cars, new modes

36. Nuran Çakmakçı, "Devrim Celal'den Jetgil Kürşad'a," Hürriyet, Last modified January 9, 2021, https://www.hurriyet.com.tr/yazarlar/nuran-cakmakci/devrimden-kumruya-41710047.

37. Safdie and Kohn, The City After The Automobile, 14.

of transportation, drone-type air transportation vehicles to be used for short-distance journeys in the city affect the fate of urban space?

2.1. From Refueling to Charging

Increasing population density and needs of metropolises, global climate and economic crises, especially the changing trends of Y and Z generations on mobility, new mobility trends have led automobile companies to question their existing products and systems. While investments in fossil fuel vehicles are decreasing for a more sustainable city and future, investments in cars powered by electricity, which is a clean energy source, have increased. Tesla, which is the leader in the position of electric car manufacturer, sold approximately 1.3 million electric vehicles in 2022, while it sold 400,000 vehicles only in the first quarter of 2023.[38] German giant Volkswagen will invest $34 billion in order to produce all its vehicles as electric or hybrid, with the aim of being the leader in the market by 2025.[39] As the electric car market grows, sales in Europe, Asia and America continue to increase year by year. According to the report of Reuters correspondent Victoria Klesty, 54.3% of the cars sold in Norway in 2020 were electric vehicles.[40] It's no surprise that sales of electric cars in Norway surpass those of fossil fuel vehicles. As a matter of fact, investments are made in a way that encourages the sale of electric cars. According to studies, there were an average of 14 charging stations per 100km distance in Norway in 2021.[41]

In the near future, with the removal of fossil fuel vehicles from the cities, what will happen to the gas stations where hundreds of cars enter and exit every day, while the charging stations that we have begun to see in public spaces and parking lots are increasing day by day? Electric cars do not come with a fuel tank that is filled with gasoline in seconds. It gets power from the huge batteries in its body but it takes longer to charge a battery than to refuel. For example, the fast charging unit called "Supercharger" developed by Tesla promises a range of just 200 miles in 15 minutes.[42] It takes an average of 40 minutes to fully charge the battery of most cars, with high-speed DC charging units located in charging stations and parking lots accessible to car owners. Charging at home or at work takes much longer (approximately 2-8 hours), even if the wall-type AC charger is installed. The promised times seem quite long compared to refueling. So what will car owners do when their cars are charging? Some predictions show us that besides the changing energy needs

38. Žiga Lesjak, "Tesla Sales, Revenue & Production for 2023: The Complete Statistics," Tridens Technology, accessed May 15, 2023, https://tridenstechnology.com/tesla-sales-statistics/.

39. Charles Riley, "The Race to the Electric Car Is Just Getting Started," CNN, accessed May 10, 2023, https://edition.cnn.com/interactive/2019/08/business/electric-cars-audi-volkswagen-tesla/.

40. Victoria Klesty, "Norway Sets Electric Vehicle Record," World Economic Forum, Last modified January 8, 2021, https://www.weforum.org/agenda/2021/01/electric-cars-record-market-share-norway-2020.

41. Žiga Lesjak, "Global Electric Car Sales and Electric Vehicle Statistics (Q2 2023)," Tridens Technology, Last modified May 5, 2023, https://tridenstechnology.com/electric-car-sales-statistics/#h-tesla-rivals.

42. "Tesla Supercharger," Tesla, accessed May 10, 2023, https://www.tesla.com/supercharger.

of the automobile, the time factor will play a critical role in the transformation of physical space. The fact that the gas station, which is usually used as a transit, is necessarily transformed into a place to spend a longer time, may also cause this transformation to take place in the focus of the individual.

Very recently, in 2021, the German giant Audi opened a center in Nuremberg, similar to airport lounges, that will provide charging services to electric vehicles and where car owners can spend time waiting while charging. The upper floor of the center, where 6 cars can be charged at the same time with the modular charging cubes on the ground level, consists of a 200 square meter rest and study hall and a 40 square meter terrace. Promising that hubs can be built in just a few days using modular and flexible containers, Audi aims to provide some of the energy needed with recyclable and sustainable sources, using batteries from old, unused and test vehicles and solar panels on the roof (Figure 17).[43] Audi plans to build and increase similar hubs in the pilot regions it has chosen in a short time. Audi's Hub looks radical compared to a gas station with fuel fillers under its huge eaves, a convenience store, and restrooms. It takes only a few minutes to fill the tank of a car with an internal combustion engine; therefore, gas stations are often used as transit and short-term stops. However, it is necessary to wait for a while to recharge the electric car. Therefore, when the car needs charging during the journey, the individual has time to breathe and spend time.

Figure 17: Audi's charging hub (Source: Audi)

Some companies are working on new initiatives, predicting that just waiting for the vehicle to recharge will not be a pleasant experience. Coffee chain giant Starbucks aims to set up charging stations in 15 stores in the United States, in cooperation with Volvo and Chargepoint, every 100 miles between Denver and Seattle. Thus according to Michael Kobore, a member of Starbucks' sustainability board, passengers will be able to plan the rest of their day while waiting for their car to charge and enjoy their time drinking coffee.[44]

Many gas stations are not yet fully prepared for the future; however, many are expanding their investments for electric charging infrastructure. Canadian oil giant Parkland, serving in 25 countries, sponsored Electric Autonomy's "The Electric Fuelling Stations of the Future" competition.[45] James Silvester, who won the first prize in the competition, put forward a linear structure emerging from a wooden and modular structure with his proposal called "More with Less". While the cars are being charged with the charging units lined up one after the other on the perimeter of the linear

43. "Audi Charging Hub: Flexible, Sustainable, Convenient," Audi, Last modified June 6, 2023, https://www.audi.com/en/innovation/e-mobility/audi-charging-hub.html.

44. Adele Peters, "Starbucks Wants to Become the Gas Station of the Future for Evs," Fast Company, Last modified March 15, 2022, https://www.fastcompany.com/90730929/starbucks-wants-to-become-the-gas-station-of-the-future-for-evs.

45. Marilia Matoso, "Gas Stations and Electric Cars: How Do They Change Cities," ArchDaily, Last modified December 10, 2022, https://www.archdaily.com/989627/gas-stations-and-electric-cars-how-do-they-change-cities.

structure, flexible volumes are defined in the interior where passengers can do sports, play games, rest and meet some of their basic needs (Figure 18). Promising that the building can easily adapt to different regions thanks to its modular structure and can be expanded or reduced according to the region, Silvester has placed a long eaves roof on the structure that can protect the charging vehicles from climatic conditions. With the solar panels placed on the roof, some of the energy required for the facility has been tried to be provided from sustainable sources.[46]

Some predictions show us that besides the changing energy needs of the automobile, the time factor will play a critical role in the transformation of physical space. The time it takes for the car to recharge is much longer than it takes to fill the tank with petrol. However, only a few minutes are enough to fill the tank of a fossil fuel vehicle. Therefore, gas stations have become one of the critical elements of urban space, as physical spaces that are usually and exited in transit, promising nothing more than serving basic needs. But the transformation of the car into a rechargeable electric machine has the potential to completely transform this situation. A radical change in the waiting time for an individual's vehicle to recharge can act as a catalyst for the transformation of physical space. The transformation of a space used as a transit into a space to spend time in for a longer period of time may also cause this transformation to take place in the focus of the individual. When today's gas stations turn into tomorrow's charging stations, they may be can turn into facilities that individuals can actively use and spend time productively.

Shell, one of the largest gasoline suppliers, is also working on how to convert existing gas stations into electric charging stations. They aim to transform a traditional fuel station in Fulham, central London, into a charging station. The station will consist of 9 175KW DC high-speed charging units placed under two new mutually facing canopies consisting of a wooden structure, replacing the traditional canopy (Figure 19). The energy produced by the solar panels placed on the roof will also try to provide one fourth of the energy needed by the facility. Thus, the station will run on 100% renewable energy, Shell claims.[47] The station will have a coffee shop where people can hang out while their cars are charging, and a convenience store from the large local chain of stores, Waitrose. In addition, Shell aims to establish 800 charging points integrated into stores and 50,000 charging points on the streets by 2025 in cooperation with Waitrose.[48]

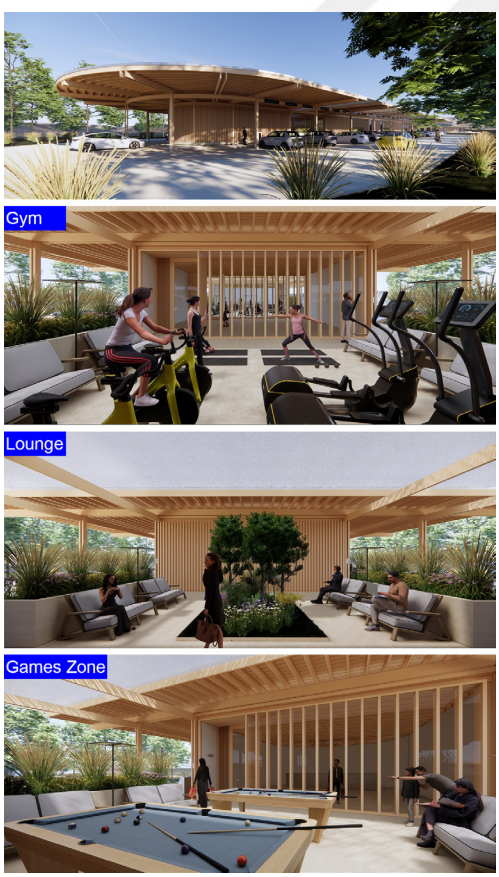


Figure 18: Michael Silvester's proposal for design competition that called "The Electric Fuelling Station of the Future" (Source: Electric Autonomy)

46. "More with Less: EV Charging Station Design: Electric Autonomy Canada," EV Charging | Electric Autonomy Canada, accessed February 21, 2023, https://evcharging.electricautonomy.ca/awards2022-more-with-less/.

47. "Shell Recharge Fulham Road, Our First UK All-EV Charging Hub," Shell United Kingdom, accessed April 21, 2023, https://www.shell.co.uk/motorist/ev-charging/shell-recharge-fulham-road-our-first-uk-all-ev-charging-hub.html.

48. "Shell Converts Gas Station Into EV Charging Hub," InsideEVs, Last modified January 6, 2022, https://insideevs.com/news/559069/shell-gas-station-ev-charging/.

The fact that a car with a petrol pump installed in its fuel tank is now plugged in will lead to serious transformations in urban space production. What an EV needs is very different from a petrol vehicle. As a result, the demands of the individual who is the user are also affected radically. It is an inevitable result that the radical change in the demand of the individual will lead to radical transformations in the production of urban space. Jordan Goldstein, Co-Firm Managing Principal of Gensler, and Neil Brooker, Global Director, Business Transformation at BMW Designworks, "How the intersection of architecture and mobility will shape the cities of tomorrow?" in their article, they argued that as cities become smarter and more electrified, traditional building types such as parking lots and gas stations are outdated and should be transformed into mixed-use, multi-modal hubs. They suggested that in the time it takes for an electric car to be charged, new typologies may emerge that can be operated with functions that can be experienced in daily life at similar times.[49] To that end, Gensler worked with BMW Designworks on a scenario where approximately 145,000 gas stations in America could be repurposed. They argued that the gas station, which is a transitive place where hundreds of fossil fuel vehicle owners enter and exit every day, should be transformed into a place where individuals can come together and interact, shop, relax, produce collectively and carry out workshops during the charging period, which will last at least 20 minutes. They stated that they aim to make this possible by transforming existing stations and adapting them to the requirements of the age. (Figure 20).[50] There is something else interesting in the 40-seconds video that Gensler posted about the hub they called "NTH Space".[51] While users continue to carry out various activities in the semi-open and closed spaces of the hub, their cars have also become a part of the space. Within Gensler's fluid space, the automobile can experience and traverse the entire space (Figure 21).

As electric vehicles become more common and more integrated into our daily lives, the city will have to adapt to it. The electric vehicle, which does not look much different from a fossil fuel vehicle in appearance and functionality, seems to have a different position in terms of daily life and experience. Many of the technological devices we own are now part of the online network. It has become controllable with the help of a mobile app that you can download from application stores to your mobile phone. It is obvious that many of the car developers aim to make their new cars a part of the online ecosystem with the help of a simple mobile app. Thanks to the mobile

Figure 19: Shell's new EV Charging Station in Fulham, London (Source: Shell)

Figure 20: A Typical Gas Station vs. Gensler's Future Hub (Source: Gensler)

49. Jordan Goldstein and Neil Brooker, "How the Intersection of Architecture and Mobility Will Shape the Cities of Tomorrow," Gensler, Last modified May 16, 2022, https://www.gensler.com/blog/bmwdesignworks-the-intersection-of-architecture-and-mobility.

50. Ibid.

51. "Nth Space," Architecture x Mobility, accessed March 16, 2023, https://www.architecturexmobility.com/nth-space.

Figure 21: Captures from Gensler's video about NTH Space (Source: Gensler)

app, the car's charge and range status, the location of the last parked place, technical data about the last driving experience and much more can be easily obtained. While Gensler argues that EVs will be the brains and technology platforms of future buildings, they think they will increasingly integrate into our homes, workplaces and common spaces. While they claim that EVs are no different from any electrical appliance in our homes, such as refrigerators, they suggest that cars can live with us inside the house, and that the home can be a hub of energy, multimedia and entertainment.[52] EVs are not much different from any electrical appliance we use at home, because they do not have the noise and toxic gas as other electrical appliances. The absence of an exhaust, its quietness, and its integration with online systems will set the EV apart from fossil fuel vehicles. Cars with which we have a more superficial relationship, which are mostly motionless in front of our door, which we use only when we need them, and which are responsible for transporting us to the location we want, are becoming obsolete. EVs will take on a more active role in our daily lives. When it starts to find a place for itself in the physical spaces where we carry out our daily activities, it will create an intermediate space within that space.

How electric cars will charge seems likely to play an important role in the production of urban space. However, the solution to this problem will not be limited to the conversion and adaptation of existing stations. Japanese auto giant Nissan argued that EVs do not need a physical place to charge. At the 2016 Auto Show in Geneva, Switzerland, they announced their future vision for cars and the city, together with Foster + Partners. Electric cars will start charging when parked in defined parking spaces on the sidewalks of the "smart street", as described by Nissan, which includes wireless charging technologies (Figure 22). When a car is fully charged, it will automatically replace it with another vehicle that needs charging, taking advantage of its autonomous driving features. With the system that allows power transfer from the car to the grid, which they call V2G (Vehicle-to-Grid), a car with a full battery will be connected to the grid of the house with the help of a cable, and will become an energy center that can provide the electricity needs of the house (Figure 23). Solar panels on the roof of the house will become another energy provider that can use the energy stored during the day for the electricity needs of the house.[53]

While electric cars, which we are seeing more and more on the streets every day, glide silently on the roads, they basically do not offer a very

52. Dylan Jones, "4 Ways Electric Mobility Will Reshape Our Cities," Gensler, Last modified August 24, 2021, https://www.gensler.com/blog/4-ways-electric-mobility-will-reshape-our-cities.

53. Dan Howarth, "Foster + Partners and Nissan Unveil Vision for Self-Charging Driverless Cars That Can Power the Home," Dezeen, Last modified March 10, 2016, https://www.dezeen.com/2016/03/01/foster-partners-nissan-technologies-future-cities-vehicles-wireless-charging-autonomous-driving-driverless-cars/.

different driving experience than fossil fuel vehicles. But as EVs are getting smarter, they go beyond being a means of transportation that is mostly used for an hour a day. We live in a digital ecosystem where we can access many data in seconds with mobile phones, interact with others with a single click, and manage electrical devices around us with mobile applications. It seems that EVs will also become one of the important infrastructure elements of this digital ecosystem. The ecosystem of fossil fuel cars consisting of highways, petrol and gas stations and parking lots in the previous era is losing its validity. An electric powered EV with no exhaust and no sound needs a much more sustainable and digital ecosystem. Gas stations are replaced by charging hubs where individuals can discharge themselves, and gasoline is replaced by electricity from wind or solar energy. The fact that the supply of electricity is much easier and more alternative than gasoline, and the possibility of charging the vehicle wherever the electrical infrastructure is suitable, seems to reduce the dependence of cars on monopolized gas stations. The possibility of charging at home, at work, in public areas, in the parking lot and many more seems inevitable for the transformation of transit gas stations with huge and valuable real estate areas today. It will become places where communities can come together and interact, where various activities can be carried out, and where the individual can store their energy and spend a productive time while the car is charging. In other words, it will cease to be monotonous spaces produced with an approach in which the automobile is a priority in the spatial needs program. The lack of exhaust and sound of the EV seems to take it from the streets and carry it to the indoor spaces where we spend most of our daily time. In the near future, as many auto companies claim, an EV will become an energy storage and multimedia system that we keep, perhaps in the interior of a home or office. In other words, even when the car is stationary, it will turn into a mobile device that takes an active role in the private space and defines an intermediate space.

Figure 22: Smart Street for EV charging (Source: Dezeen)

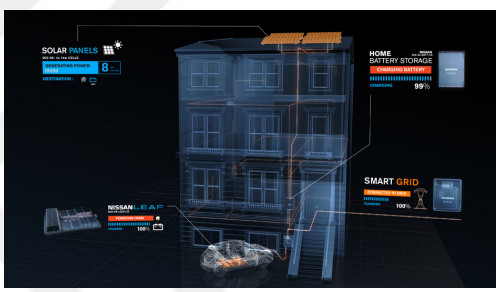


Figure 23: V2G System for energy sharing (Source: Dezeen)

2.2. Autonomous Spaces

Today, automobile companies dream of much more than producing and selling a new vehicle. They dreams that the vehicle they produce will be one of the important infrastructural elements of the digital ecosystem and the city. Equipped with advanced sensors, mapping technologies and artificial intelligence, EVs promise to provide a more comfortable driving experience,

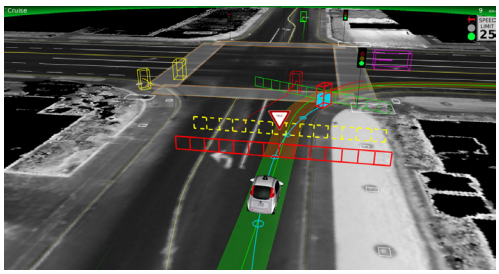


Figure 24: Diagram of an "interesting situation" described by Waymo; the car stopped to yield to an oncoming cyclist (red rectangle) traveling against the traffic flow. (Source: Waymo)

to be greener and safer. It seems that the integration of such technologies with the automobile will take it beyond being an individual-controlled means of transportation. It is dreamed that the automobile equipped with technologies such as artificial intelligence, lidar sensors, cameras and GPS will turn into autonomous vehicle (AV) that can process the data it receives from the built environment, instantly react and adapt to the situation it is in, and interact directly with the city and its inhabitants (Figure 24). It would not be wrong to say that the role of a self-determining car without a steering wheel, and therefore without a driver, in urban space will change radically. How will a car that can drive on its own, park after unloading its passengers, drive to the required point when it needs a charge, and program itself, will affect our daily life and therefore the urban space? Beyond that, how will the interior space of the car, designed for the comfort of the driver, take shape when the steering wheel is removed? How will the interior transform when the responsibility of controlling the vehicle that carries us from where we are in the public space to where we want to go is no longer the responsibility of human beings?

The mobility of the future will not be limited to the way we move around the city. With EVs being equipped with autonomous driving features, it seems that the disappearance of the driver and steering wheel will lead to the transformation of the physical interior of the car. In the scenario where there is no driver, the car will have the potential to go beyond being a means of transportation that carries passengers from point A to point B, and transform into an intermediate place where passengers can spend productive time. The driver will no longer have to follow the road behind the wheel. The time the driver spends behind the wheel in traffic will now be transformed into time that one can devote entirely to oneself. The autonomous driving level, where the steering wheel is completely eliminated and the user does not have to control the car, is called level 5 according to SAE (Society of Automotive Engineers) (Figure 25).[54] The vehicles offered to the end user have not yet reached the 5th level. While Tesla's vehicles on the market have reached level 2 autonomous driving certificate, Mercedes-Benz is the only company that has reached level 3.[55] Level 5 vehicles have not yet become a part of the urban space, both due to the lack of legal grounds and the lack of technological infrastructures yet. However, many research projects on the city of the future are shaped by fully autonomous vehicles.

54. "Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles," SAE International, Last modified April 30, 2021, https://www.sae.org/standards/content/j3016_202104/.

55. Cat Dow, "What Are the Six SAE Levels of Self-Driving Cars?," Top Gear, Last modified March 6, 2023, https://www.topgear.com/car%20news/what-are-sae-levels-autonomous-driving-uk.

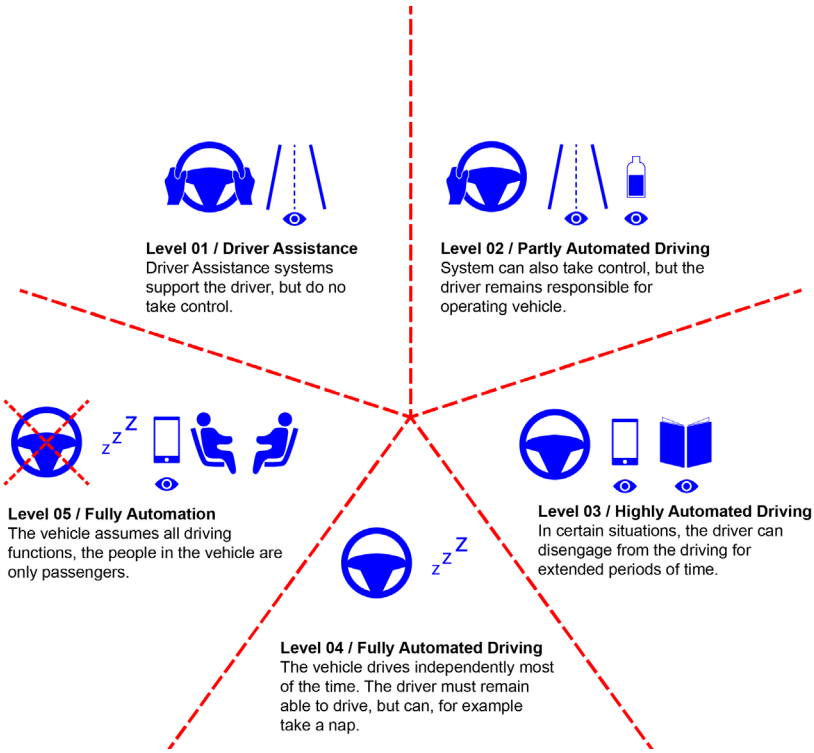


Figure 25: Autonomous Level Diagram

In a conventional vehicle, the most important passenger is the driver himself/herself. Because the person who takes control of the vehicle is the driver. Therefore, the design of the vehicle's interior depends largely on the comfort of the driver. When the driver's comfort emerges as the most fundamental issue affecting design, the overall design depends on what is left of the driver. In conjunction with autonomous vehicle technology, the driver's disengagement from the steering wheel with the car freed from human control can be a catalyst to transform the automobile space. The driver no longer has to follow the road with full attention while behind the wheel. This offers both the driver and other travelers the potential to create productive space and time. It can also create an interactive interior with its technologies (like AR) allowing users to interact more with the city and online systems. In addition, they can become mobile spaces that bring various social and cultural services to the individual's feet (Figure. 26).

Copenhagen-based research-based design studio SPACE10 has worked on a project that explores how fully autonomous vehicles can contribute to everyday life. In the project they named "Space on Wheels", they developed suggestions on the variations of autonomous vehicles that

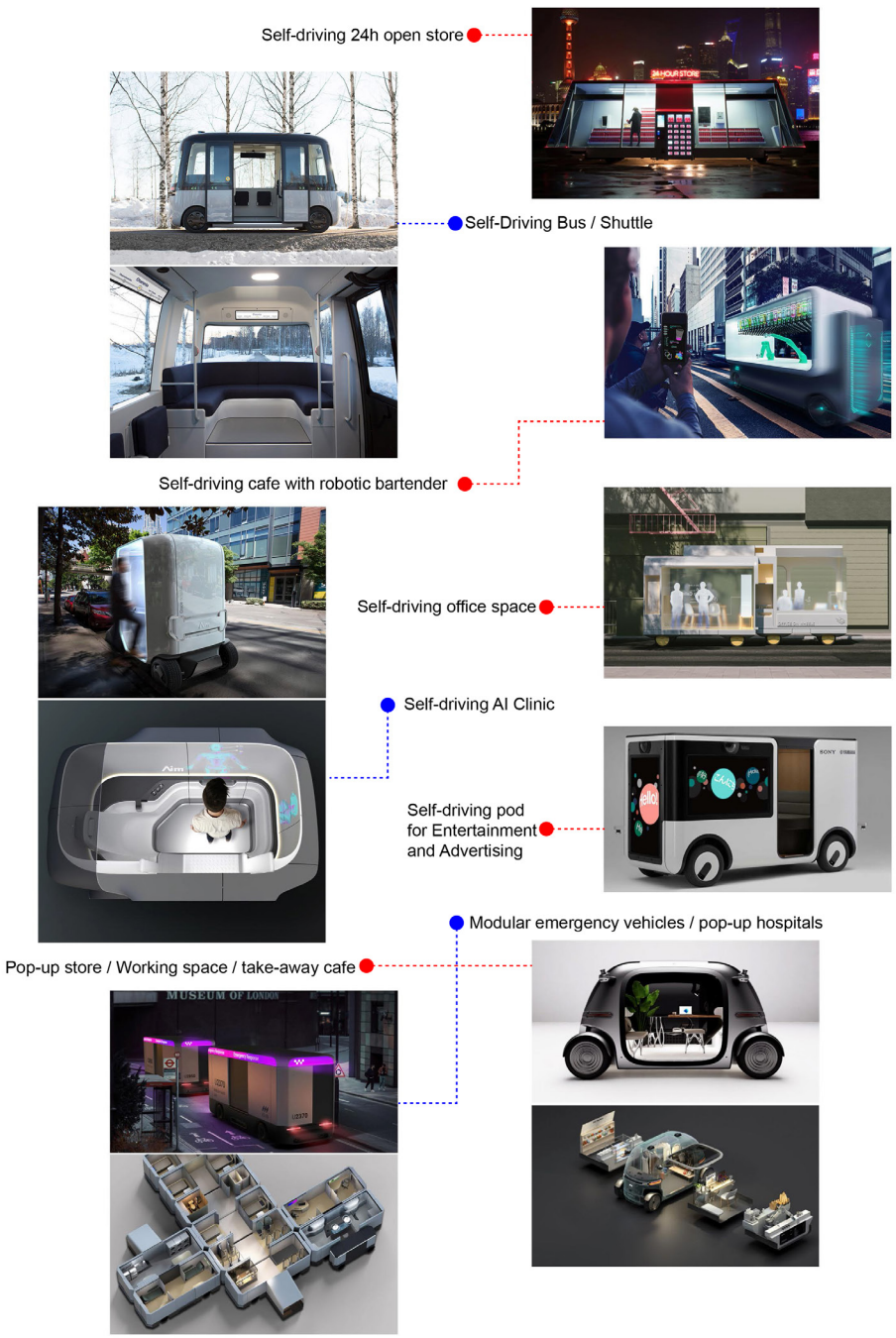


Figure 26: Autonomous spaces providing various social and cultural services

become driverless, diversify according to different needs, and serve to the feet of individuals (Figure 27). They offered suggestions called “Office on Wheels” for passengers who lost about 75 minutes in traffic on their way to work in congested cities, “Cafe on Wheels” for passengers who want to socialize and spend quality time during the journey, and “Hotel on Wheels” for individuals who want to rest or sleep especially during the long journey.[56] One of the main goals was to regain the time lost during the journey to the individual. In addition, they offered a series of suggestions for communities that have difficulty in reaching basic needs: “Healthcare on Wheels” for individuals who have difficulty in accessing social health services, “Farm on Wheels” for individuals who have difficulty in accessing quality and cheap food, “Shop on Wheels” for retail stores that can serve individuals to their feet as mobile shops.[57] The proposals of SPACE10, which is completely different from a traditional car, consist of mobile spaces that move on its wheels rather than a car. The traditional car itself, of course, defines a mobile space. However, it mostly offers a limited space experience where passengers have to sit in the direction of movement during the journey and the driver has to follow the road at the wheel. The disappearance of the steering wheel seems to promise passengers a place in the interior of the car where they can perform activities they could not imagine before. Although the aforementioned proposals may seem very utopian, many research projects intersect at similar points.

Figure 27: Space on Wheels (Source: SPACE10)

56. “Spaces on Wheels: Exploring a Driverless Future,” SPACE10, accessed March 3, 2023, https://space10.com/project/spaces-on-wheels-exploring-a-driverless-future/.

57. Ibid.

Figure 28: Usage of PBV's (Purpose Built Vehicles) (Source: Hyundai)

Figure 29: The HUB with PBV and UAM (Source: Hyundai)

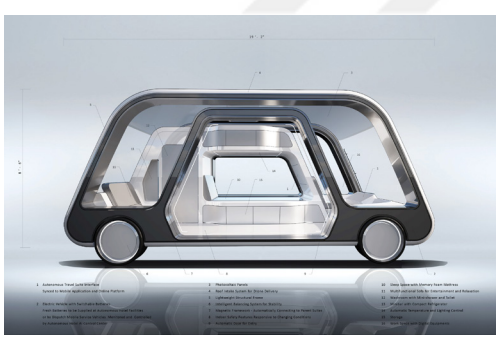


Figure 30: Autonomous Travel Suite (Source: Aprilli)

In 2020, Hyundai announced autonomous vehicles called "Purpose-Built-Vehicle" (PBV), in which the interior varies according to various functions and can vary in size, with an attitude similar to the approach of SPACE10 (Figure 28). PBVs were defined as self-driving vehicles that support private or public transportation modes and provide road transportation. Hyundai was actually revealing a mobile ecosystem consisting of 3 parts rather than an autonomous vehicle. The vehicles they named UAM (Urban Air Mobility) supported short-haul air transportation in the city. The fixed spaces, which they named "Hub" with a circular form, were a transfer and activity center where 10 PBVs could be connected with the docking station on the periphery, where the UAM could land with the landing surface on the roof, and where communities could come together for different purposes (Figure 29). In addition, Hubs were defined as functional spaces that could provide various social services according to the needs in the city. For example, PBVs functioning as mobile health units were connecting to the Hub, turning it into a fully equipped health center.[58]

Toronto-based Aprilli design studio has done a study on how time lost on long journeys can be productive. In a large geography like America, there is a 6-12 hour drive between major cities. If airplane or public transportation modes are preferred, the obligation to use a secondary transportation vehicle to access the airport or station, extended waiting times due to transfer, check-in and security procedures enabled Aprilli to focus on autonomous driving as an alternative transportation method. The autonomous vehicle, which they named Autonomous Travel Suite (ATS), offered a compact and mobile hotel room where passengers could relax and enjoy themselves during long journeys.[59] The interior, in which basic functions such as sleeping, working and cleaning can be performed, aims to make the time spent during the journey productive (Figure 30). In an interview with CNN, Aprilli Design Studio founder Steve Lee talks about seeing autonomous vehicles as a mobile room, while auto companies are focused on developing traditional vehicles as a more advanced version.[60] With the help of the mobile app, Autonomous Travel Suite will provide services in such a way that passengers can determine the starting and ending points, and also mark the stopping points in order to meet their various needs along the route. According to Lee's vision, the ATSs will be managed by a facility he calls the Autonomous Hotel Chain. This space is defined as a hub where the technical maintenance of the cabin can be met and the need for charging can be met. The facility, which has a circular form, consists of volumes where various activities such as hotel rooms, gym,

58. Hyundai Motor Company, ed., "Hub and PBV: The Essence of the Future Mobility," Hyundai Motor Group, Last modified January 13, 2020, https://www.hyundaimotorgroup.com/story/CONT0000000000000789.

59. "Autonomous Travel Suite," APRILLI, Last modified October 3, 2018, http://www.aprilli.com/autonomous-travel-suite.

60. Sarah Lazarus, "This Self-Driving Hotel Room Could Revolutionize Travel," CNN, Last modified November 20, 2018, https://edition.cnn.com/travel/article/autonomous-travel-suites/index.html.

swimming pool, restaurant can be performed for passengers. In addition, ATSs can be connected to hotel rooms with the help of a dock, allowing the interior space to expand. (Figure 31).[61]

The fact that the automobile of the future goes beyond just being a means of transportation and finds a place more actively in daily life is a situation that is often described. It seems that the automobile will become a part of the building where we spend most of our daily time, except for going from point A to point B, where it performs its main function. South Korea-based Hyundai claims that until now we have been limited by the spatial boundaries between buildings and vehicles, but these boundaries will be broken with the spread of autonomous technologies and artificial intelligence.[62] They claim that the car of the future can be integrated into the living space with the help of a dock and can be a technology base that creates the multimedia and entertainment system of the space. Seats designed for passengers inside the car can also become part of the living space when the car is integrated into the home (Figure 32).[63] The cars of the future will cease to be just a transportation cabin, but become mobile spaces that can offer new spatial experiences, diversifying according to various functions. This seems to help people go beyond the spatial boundaries that they are stuck in in their daily life.

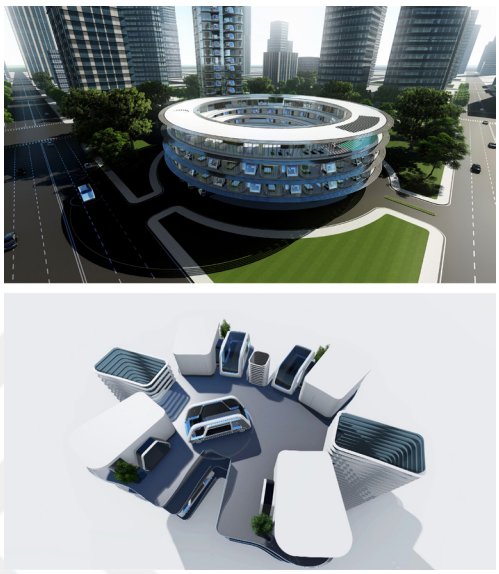


Figure 31: Above is a perspective image from Autonoous Hotel Chain designed by Aprilli, below is an image from an integrated Autonomous Travel Suite (Source: Aprilli)

Figure 32: An attached vehicle to the living unit that controls the entertainment system, reads notifications of users, etc. (Source: Hyundai)

2.3. Shared Surfaces

Throughout history, societies' mode of transportation and their mobility within the city have emerged as one of the most important elements that transform the city and social life. With the emergence of the automobile,

61. APRILLI, "Autonomous Travel Suite."

62. "Hyundai Motor Presents Smart Mobility Solution 'UAM-PBV-Hub' to Vitalize Future Cities," Hyundai Motor Group, Last modified January 7, 2020, https://www.hyundaimotorgroup.com/news/CONT0000000000000916.

63. Hyundai Smart Connect Home CES 2017 Cars UK, 2017, https://www.youtube.com/watch?v=ipTeicYPHjw&ab_channel=CarsUK.

64. Henry Grabar, "Is the Tiny Little Neighborhood the City of the Future?," The Guardian, Last modified January 25, 2023, https://www.theguardian.com/us-news/2023/jan/25/15-minute-city-urban-planning-future-us-cities.

65. Lizzie Crook, "15-Minute City Concept by Carlos Moreno Wins Obel Award 2021," Dezeen, Last modified October 26, 2021, https://www.dezeen.com/2021/10/26/15-minute-city-carlos-moreno-obel-award/.

66. Rory Cellan-Jones, "Uber's Self-Driving Operator Charged over Fatal Crash," BBC, September 16, 2020, https://www.bbc.com/news/technology-54175359.

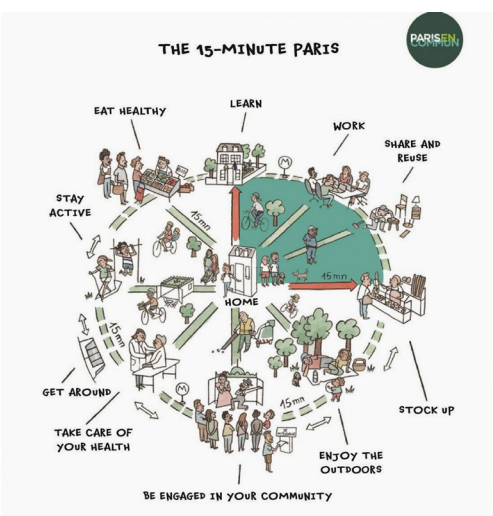


Figure 33: 15 minutes city illustration (Paris) by Micaël (Source: Dezeen)

the city of the 20th century began to expand beyond its traditional borders. New typologies and infrastructural elements serving the automobile have become the new figures of the city. Highways designed for the movement of automobiles, large-scale structures in the building blocks bordered by highways have become the elements that form the character of the modern city. In other words, radical transformations in transportation in the 20th century laid the foundations of today's cities. In the current period, there are great developments in terms of mobility. With electric and autonomous vehicles becoming a part of urban space and daily life in the very near future, the mobility trends of societies will change. Therefore, the radical evolution of the automobile will deeply affect the urban space, just as the urban space and the way of doing architecture have been transformed as a result of the automobile's inclusion in daily life in the 20th century.

In the current period, many urban planning policies focus on constructing city centers as spaces where pedestrian interaction is a priority, as in the pre-car city, free from vehicle traffic or restricted to vehicle traffic. For a more sustainable, more livable and healthy city life, Professor Carlos Moreno, an urban scientist at Sorbonne University, introduced the 15-minute city concept in 2016.[64] According to this concept, it is aimed that all basic services and daily needs in the city will be accessible by the individual in 15 minutes by walking or cycling (Figure 33). While Moreno claimed that with this approach, megacities would get rid of the hegemony of cars and promise a more sustainable life, he dreamed of decentralized, self-sufficient cities.[65]

It is believed that driverless vehicles will also play an important role in the pedestrian-oriented design of city centers. Many predictions about driverless vehicles seem to play an important role in improving urban space. Many authorities claimed that autonomous vehicles would be on the road in a few years, reducing traffic congestion and providing a safer driving experience. However, it seems that technology and regulations are not ready for this yet. In 2018, in Arizona, Uber's robo-taxi crashed into Elaine Herzberg, who was crossing the road with her bike, causing the woman to die. Uber, which did not take responsibility for the accident, found that safety driver Rafaele Vasquez, who was in the vehicle, was not looking at the road at the time of the accident. Vasquez's trial is ongoing. The crash was recorded as the first fatal accident involving a self-driving car, and Uber suspended self-driving taxi tests in Arizona.[66]

According to many common opinions and studies, driverless vehicles

will help reduce urban traffic density and minimize accident rates. The National Highway Traffic Safety Administration (NHTSA) has revealed that 94% of traffic accidents are caused by driver errors.[67] However, according to the report published by the Canadian Transport and Communications Committee in 2018, the increasing prevalence of AVs will reduce accident rates by 80%, if not completely.[68] So, how will the urban space be affected when the car has enough technology for a completely autonomous driving experience and the necessary regulations are completed?

In order to test the potential of autonomous vehicles and artificial intelligence, cities that are planned to be built from scratch are being designed. Today, the potential of self-driving vehicles is being tested in American cities such as Los Angeles and San Francisco, many of which are fairly well-designed, as well as in the Netherlands, Beijing and London, to collect data along with various robo-taxi applications. However, it is a big question mark how autonomous vehicles will adapt to the urban space in cities like Istanbul that are developing organically and quite irregularly. However, Bogazici University faculty member and director of the "Smart and Autonomous Mobility Laboratory" Sinan Öncü reveals that compared to European cities, Istanbul creates an environment that provides much more opportunity for the development of autonomous vehicle technologies:

> "When collecting data for autonomous vehicles in the Netherlands, we sometimes needed data on errors and violations. In this way, we could test the system against different situations. However, the country is very calm and the drivers mostly follow the rules. This made our job harder. Istanbul is a densely populated city and drivers can ignore the rules from time to time. This gives us a great opportunity to collect data for the further development of autonomous vehicle technologies. The conclusions we draw from human errors can enable this technology to advance even faster. Istanbul is therefore a great city for this business."[69]

Developing artificial intelligence-based software products called Eatron, which started driverless car test drives for the first time in Turkey, CEO of Eatron, Dr. Umut Genç has similar thoughts to Öncü. While he argues that Istanbul's traffic provides a challenging test and development environment, he claims that an autopilot that is successful in Istanbul will work much better

67. Pete Burns, "What Percentage of Car Accidents Are Caused by Human Error?," Burns, Cunningham & Mackey, P.C., Last modified April 23, 2020, https://www.bcmlawyers.com/what-percentage-of-car-accidents-are-caused-by-human-error/.

68. Driving Change: Technology and the Future of the Automated Vehicle, Senat Du Canada, 2018, https://sencanada.ca/content/sen/committee/421/TRCM/Reports/COM_RPT_TRCM_AutomatedVehicles_e.pdf, 30.

69. Berat Haznedaroğlu, "Boğaziçi'nde Tasarlanan Otonom Araç Projesi Bildiğimiz Tarımı Değiştirebilir," Boğaziçi'nde Bilim, Last modified 2017, https://bogazicindebilim.boun.edu.tr/content/bogazicinde-tasarlanan-otonom-arac-projesi-bildigimiz-tarimi-degistirebilir.

in other European cities.[70] Seval Öz, an autonomous vehicles and artificial intelligence expert who runs Google's driverless vehicle project, claims that Istanbul's traffic problem will be solved with autonomous vehicles and their shared use. She also believes that autonomous vehicles will contribute to a decrease in the number of personal vehicles and a more stable flow of traffic.[71]

Many new city visions suggest that city centers should be designed as pedestrian-oriented spaces that are restricted to vehicle traffic or free from vehicle traffic. The Danish architectural firm BIG has put forward a project that support this. BIG plans to build a new city called Telosa, which will have a population of 5 million, spread over 150,000 acres in the middle of the US desert.[72] Telosa aims to be built in accordance with the 15-minute city concept proposed by Moreno. The city, which consists of 36 dense centers, was designed to meet the daily basic needs of the city's residents within a 15-minute walk. In addition, the city center consists of a green spine, which they refer to Central Park in New York, and this green space spreads to every corner of the city. In addition, important buildings such as museums, stadium, music hall, conference center in the city are dispersed to various points of the city along the green spine, instead of concentrating in a single center (Figure 34).[73] Would it be correct to comment that Wright's dream of Broadacre in 1932 , which is self-sufficient, does not have a centralized understanding, and where the density is homogeneously distributed, becomes reality?

Figure 34: Bird's eye view of Telosa (Source: Dezeen)

In public spaces where the pedestrian is a top priority, micro-mobility vehicles such as bicycles and e-scooters help support mobility. However, beyond this, some studies reveal that compact autonomous vehicles with less

70. Esra Öz, "'Türkiye'de Ilk Sürücüsüz Otomobil Test Sürüşlerine Başlandı,'" Independent Türkçe, Last modified April 30, 2021, https://www.indyturk.com/node/352396/bilim/türkiye'de-ilk-sürücüsüz-otomobil-test-sürüşlerine-başlandı.

71. Tolga Yanık and Musab Turan, "'Otonom Araçlar İstanbul'da Trafik Sorununu Bitirecek,'" Anadolu Ajansı, Last modified May 3, 2019, https://www.aa.com.tr/tr/bilim-teknoloji/otonom-araclar-istanbulda-trafik-sorununu-bitirecek/1468779.

72. Tom Ravenscroft, "Bjarke Ingels Designing 'New City in America' for Five Million People," Dezeen, Last modified September 1, 2021, https://www.dezeen.com/2021/09/01/bjarke-ingels-telosa-city-marc-lore/.

73. Nat Barker, "Big Designing Ground to Air Driverless Vehicle for American Desert City Telosa," Dezeen, Last modified August 5, 2022, https://www.dezeen.com/2022/08/05/big-designing-autonomous-vehicle-telosa/?li_source=base&li_medium=bottom_block_1.

74. Ibid.

capacity and traveling at low speeds can contribute to mobility in pedestrian-oriented urban centers. BIG has presented an autonomous vehicle in Telosa that will support mobility and adapt to different modes of transport. Supporting ground-to-air (G2A) modes of transport, the vehicle consisted of three parts: a rhombus-shaped passenger cabin, a set of wheels and rotor blades (Figure 35). BIG partner Goldweit promised that the vehicle they presented would travel at lower speeds on pedestrian-shared level streets in the city, while when elevated it could join a train that could reach high speeds and even join a hyperloop chain underground (Figure 36). It could also support air transportation by turning into a kind of helicopter with rotor blades that can be integrated at the top. In addition, Goldweit claimed that providing urban mobility with autonomous vehicles would eliminate sidewalks and parking spaces, and vehicles would be stored in automatic compartments underground.[74] One of the most striking things about Goldweit's promise was level streets with no sidewalks. The render images they published about the project also support this. The different elevations and sharp boundaries separating vehicles and pedestrians seem to be lost in each other (Figure 37). It seems that this will be possible if the car is able to respond to what is happening around it, and to stay true to the artificial borders and regulations drawn for it. Designing surfaces for different purposes and different speeds within the urban space can also make this possible. Is it possible to say that the sidewalks that draw a sharp boundary between pedestrians and cars in the current period will dissolve in the urban space in the near future?

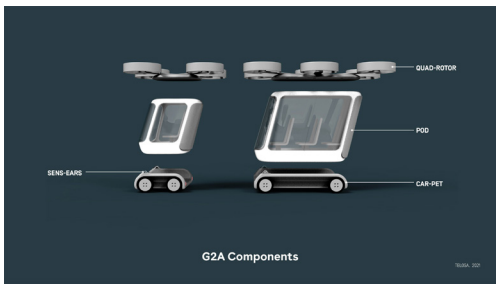


Figure 35: BIG's autonomous vehicle for Telosa that supports ground-to-air (G2A) modes of transport (Source: Dezeen)

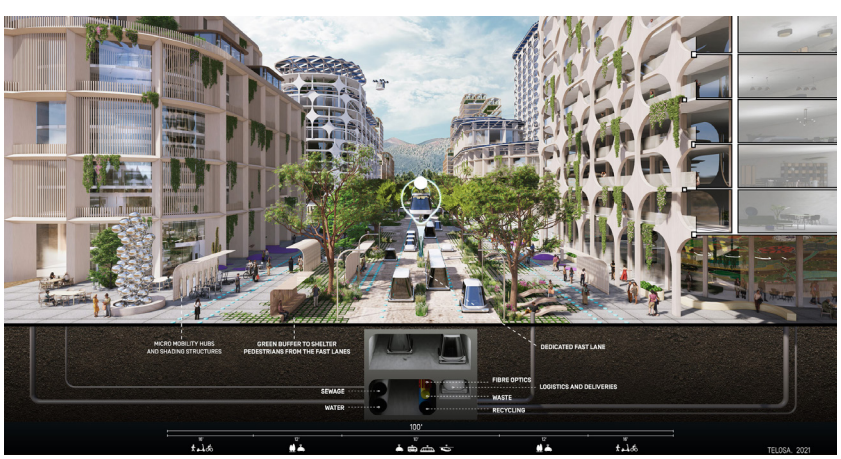


Figure 36: A section from district corridor (Source: Dezeen)

Figure 37: A section from neighborhood corridor (Source: Dezeen)

A city where the pedestrian is a priority, where the automobile does not interrupt the pedestrian flow, where pedestrians can wander freely in the middle of the streets without constantly looking around seems like a very utopian dream. However, many predictions about the city of the future reveal that this utopia could be possible. Today's auto giants are very interested in what the city of the future should be like. Japanese giant Toyota is working on a former automobile factory land at the foothill of Mount Fuji, in collaboration with BIG, on a new city that will house 2000 people, which will come together from solid wood structures with photovoltaic panels on its roof, autonomous vehicles, robots and artificial intelligence. The city, which they call Woven City, is designed to be powered by sustainable sources such as hydrogen fuel cell, geothermal and solar energy. Toyota President Akio Toyoda imagines Woven City as a living laboratory where individuals, buildings, robots and vehicles interact with each other with the help of data and sensors, where artificial intelligence can be tested in both virtual and physical environments.[75] Woven City is basically designed as a city with a gridal planning approach, consisting of repetitions of 3x3 building blocks, each of which has a green courtyard in the middle, and axes with different mobility modes that separate the building blocks from each other. By deforming the grid composition, the large green courtyards in the center of the campus were expanded. Axes that support mobility in Woven City are shaped by different modes and speeds: high-speed main streets used by autonomous vehicles, streets and recreational axes where micro-mobility vehicles support mobility, and finally, linear green streets that are only open to pedestrian access (fig. 38).[76]

75. Ravenscroft, "Bjarke Ingels designing "new city in America."

76. Christele Harrouk, "BIG Designs Toyota Woven City, the World's First Urban Incubator," ArchDaily, Last modified January 8, 2020, https://www.archdaily.com/931468/big-designs-toyota-woven-city-the-worlds-first-urban-incubator?ad_source=search&ad_medium=search_result_all.

77. Toyota Woven City Squint / Opera, 2020, https://www.youtube.com/watch?v=BONZLgt1G2U&ab_channel=Squint%2FOpera.

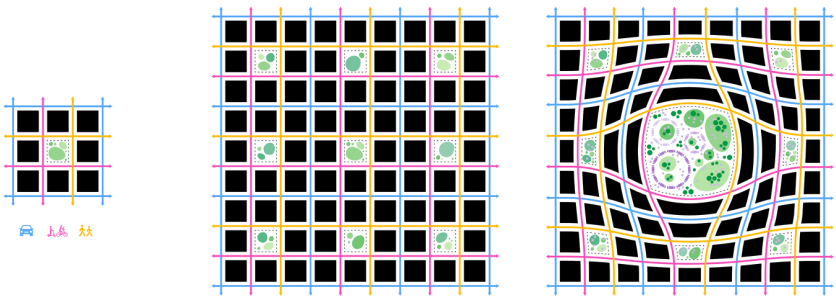


Figure 38: The schematic plan of Woven City with a grid composition, formed by axes designed for different mobility modes. (Source: Bjarke Ingels Group)

In his presentation, Bjarke Ingels argues that typical transportation axles are chaotic, and reveals that they first started by classifying these axles according to 3 different modes. He then reveals that these streets with different modes of transportation intersect each other, forming the 3x3 building blocks of Woven City. Thus, he defines the courtyards, which are the intersection points of the axes, as an interaction space where robots, humans and autonomous vehicles come together (Figure 39).[77] In the visual images and videos published about Woven City, it seems quite possible to say that the boundaries between the pedestrian and the car have disappeared or dissolved into each other. Even though there are streets defined for each mode of transportation, it seems impossible to talk about elements such as sidewalks and traffic lights, which are seen as indispensable infrastructural elements of today's urban space, preventing the flow at intersections. Together with the ramps integrated into the facades of wooden structures, autonomous vehicles can access at different levels of the structures (Figure 40). Mobility within the urban space proceeds uninterruptedly. While mobility is ensured uninterruptedly, the dominance of automobiles seems to come to an end. The public space promises a democratic and shared space that allows all modes of mobility equally.

Figure 39: A shared, highly interactive public space in Woven City (Source: Bjarke Ingels Group)

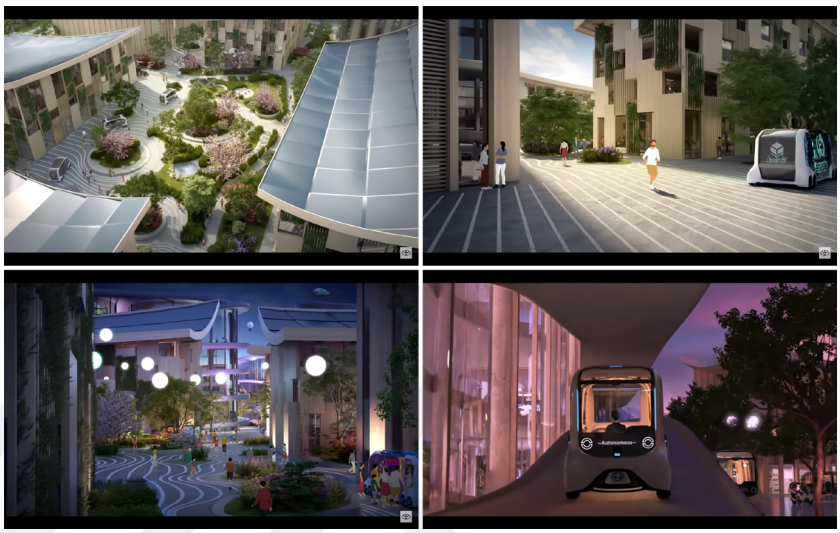


Figure 40: Captures from videos about Woven City showing uninterrupted mobility (Source: Bjarke Ingels Group)

The concept of "Shared Space" emphasized in the previous paragraph does not stand out as a concept emphasized by Toyota or BIG. "Shared Space" emerges as an approach that rejects traditional traffic laws, put forward by the famous traffic engineer Hans Monderman. According to Monderman's theory, increased traffic regulations reduced the need for pedestrians and drivers to pay attention to what was going on around them. He thought that the way to improve road safety and quality of life in the urban area was to eliminate elements that control traffic such as traffic lights, traffic signs, pedestrian crossings, lane markers and even pavements. Thus, pedestrians, drivers and cyclists would interact with each other and take more responsibility, make better decisions and ensure road safety. Although Monderman's idea may seem very utopian, he has developed "Shared Space" in more than 100 different regions, notably his native Netherlands.[78]

Monderman has redesigned a central intersection in the Dutch town of Drachten with a population of 45,000 (Figure 41). A total of 30 collisions and 4 injuries occurred in the previous 7 years at the intersection, where traffic signs and pavements were completely removed. In the 2 years since its redesign, only 4 crashes have occurred. Although studies have observed that accident rates decrease in areas designed in accordance with the "Shared Space" theorem, up to 46% in the Dutch town of Haren and up to 50% in Laweiplein, urban residents feel less safe in the absence of traffic lights and pedestrian crossings. they said they felt.[79] Therefore, local governments did not want to take much responsibility on the issue and they are bringing back traffic lights and pedestrian crossings again.

78. "Hans Monderman," Project for Public Spaces, Last modified December 31, 2008, https://www.pps.org/article/hans-monderman.

79. Viveka van de Vilet, "Space for People, Not for Cars," Works That Work, Last modified Winter 2013, https://worksthatwork.com/1/shared-space.

The inclusion of autonomous vehicles in everyday urban life has the potential to significantly change the dynamics of urban space. Thanks to its technologies, AVs can help transform the urban space into an egalitarian public space that allows all modes of mobility equally and does not provide transitional rule. In this context, it may lead to the disappearance of pavements that draw sharp boundaries between pedestrians and cars. On completely reserved surfaces, it can reach high speeds and connect two different points in the city. Many studies have shown that AV, together with its technologies, offers a more accurate driving experience than a human-driven vehicle, and as a result of its shared use, the roads reserved for vehicles will narrow, the following distance in traffic will decrease, the demand for roadside vehicle parking areas will decrease, and foresees that these areas will be brought to pedestrians (Figure 42). Hod Lipson and Melba Kurman in their book "Driverless: Intelligent Cars and the Road Ahead" state that as a result of AVs providing a more accurate driving experience, vehicle following distance in traffic will decrease. According to a University of Texas study, a shorter following distance will reduce traffic jam delays by 60% on highways and 15% on suburban roads.[80] In addition, Luis Martinez of the International Transport Forum predicts that the total number of vehicles will decrease by 90% if AVs are used in a shared manner, as AVs replace traditional vehicles.[81] The decrease in the number of vehicles may indicate that both the need for parking spaces and the roads reserved for automobiles will decrease and the number of lanes will decrease.

Based on these predictions, Daya Zhang divides the surfaces that make up urban space into two as "Shared Surface" and "Efficient Surface" in her thesis titled "Urban Life with Autonomous Vehicles". The "Shared Surface" is a mixed-use surface where the speed of vehicles is limited by the speed of pedestrian movement, giving equal right-of-way to all modes of mobility. "Efficient Surface", on the other hand, is the surface reserved for AVs, where urban travel is carried out, consisting of two lanes with a width of 3 meters, where the speed limit is determined as 20mph in the urban space. There is also another lane, approximately 1.5 meters wide, reserved for bicycles only, next to both lanes. There are no clear boundaries and elevation differences in the urban space, which consists of productive and efficient surfaces. The efficient surface is interrupted at the point where it meets the shared surface. The AV slows down on the shared surface between the two fertile surfaces and continues to move with human speed. For example, a junction point is

80. Lipson and Kurman, Driverless: Intelligent Cars and the Road Ahead, 64-65.

81. Lipson and Kurman, Driverless: Intelligent Cars and the Road Ahead, 58.

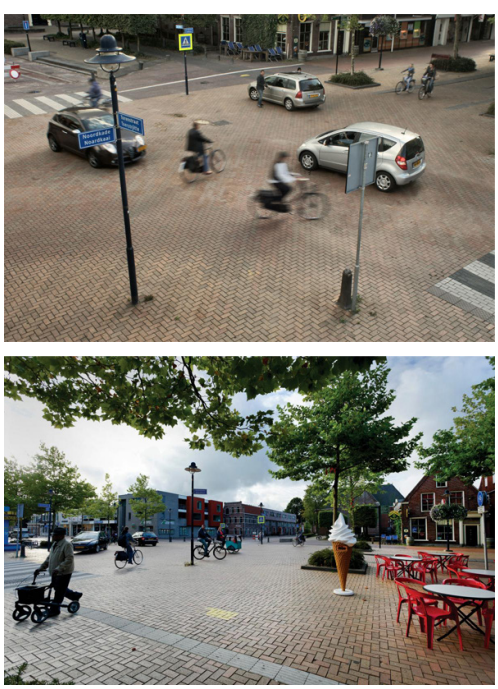
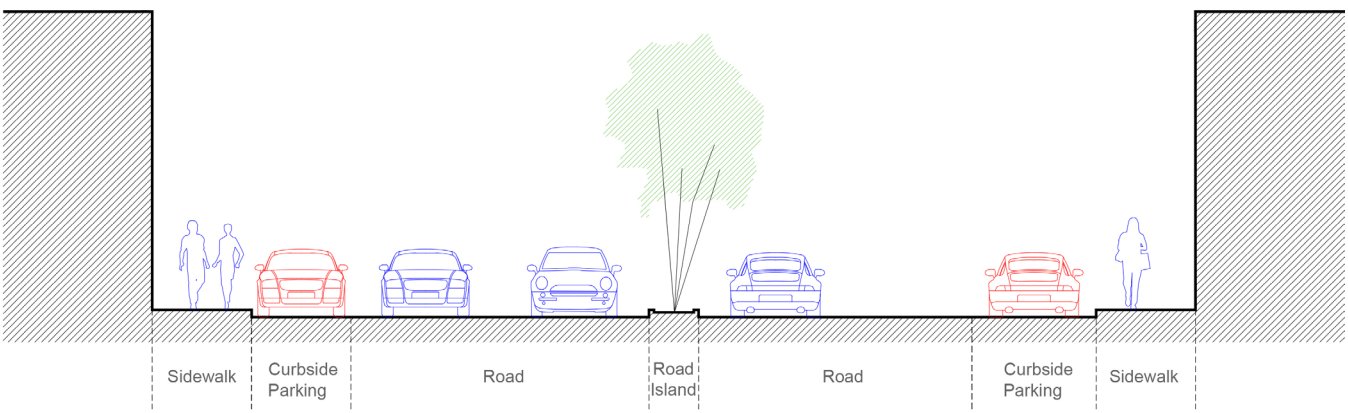
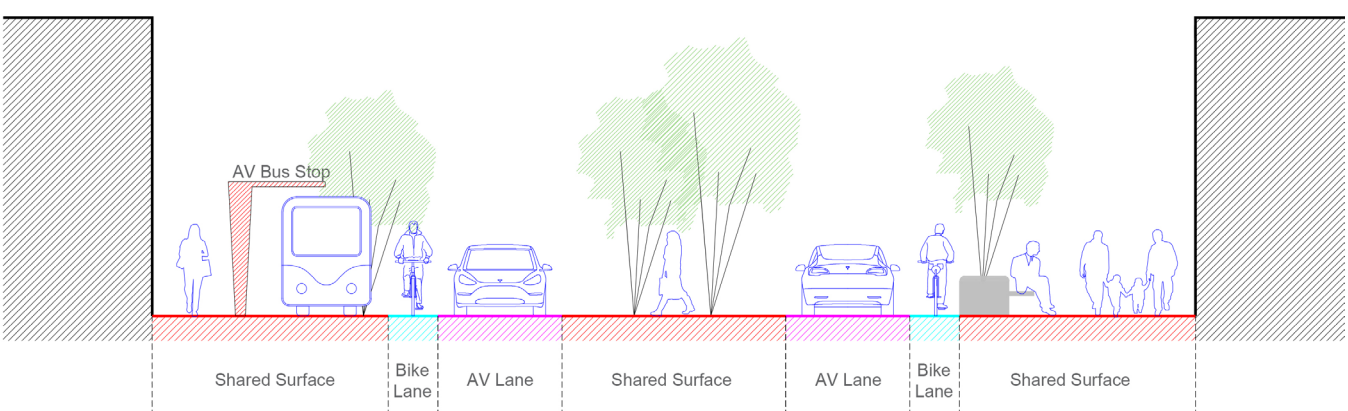


Figure 41: A junction where Monderman's Shared Space theorem is applied in Drachten (The top one is taken by Peter Biľak and the bottom one is from Raban Haaijk)



Section of typical street



Section of future's potential shared street

Figure 42: Comparison of typical street and shared street through sectional drawings

defined as “Shared Space”. So when the AV comes to the intersection, it is now on a shared surface and has to reduce its speed until it reaches the efficient surface (Figure 43).[82]

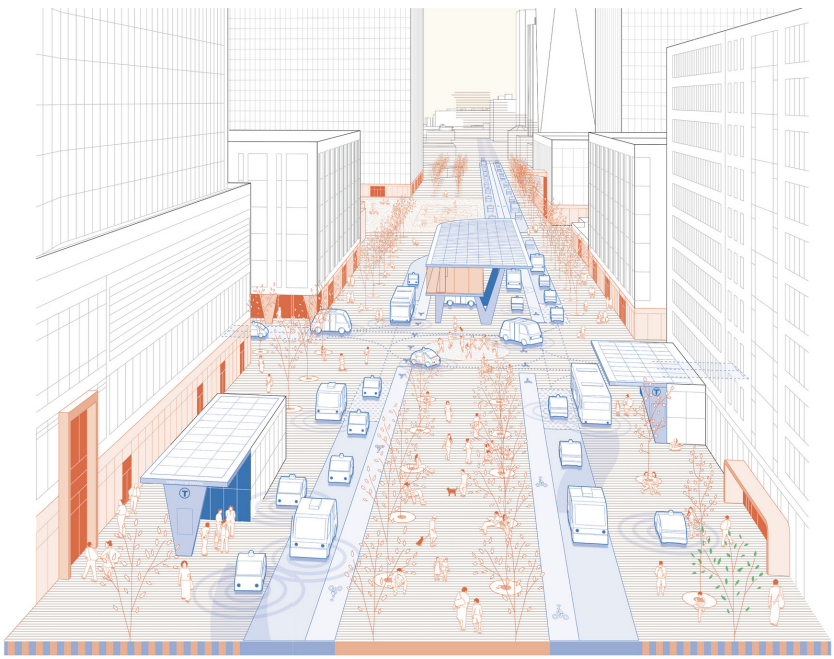


Figure 43: According to Zhang’s future projection, Boston Seaport Boulevard consisting of shared and efficient surfaces (blue: efficient surface, orange: shared surface) (Source: Daya Zhang)

Monderman’s main goal was to transform the public space from being a traffic-serving space into a human-serving space. While Monderman’s dream has not been widely embraced, the rise of autonomous vehicles seems to have the potential to make it happen. Most transportation planners say roads will narrow in the future. Because it is believed that an autonomous vehicle will offer a more accurate driving experience than a human-controlled vehicle. At the same time, the shared use of autonomous vehicles, the fact that it continues to operate to pick up another passenger after unloading the passenger, may mean that the reserved areas with car parking spaces on the side of the road will also decrease. With the demand for parking and vehicle ownership rates falling, it may mean that we will see less of the roadside parking spaces. It can also be said that the need for new loading and drop-off points will increase for passengers. The autonomous vehicle, which reacts to situations and obstacles with its advanced sensors and artificial intelligence, can stop when it encounters pedestrians to give them the right of way. By adhering to the artificial borders and restrictions drawn for it, it can contribute to the improvement of the public space and make it a pedestrian-oriented

82. Daya Zhang, “Rethinking Streets: Urban Life with Autonomous Vehicles” thesis, Massachusetts Institute of Technology, 2018, 52-56.

space. On shared surfaces where vehicles, pedestrians and cyclists gather, instead of demanding the right of way, it can turn into a robot accompanying their speed. The flexibility provided by autonomous vehicles can act as a catalyst for the blurring or disappearance of the pavements that sharply separate the pedestrian and the car. On the surfaces completely reserved for AV, it can reach high speeds and turn into a transportation vehicle that performs urban transportation efficiently. The contribution of autonomous vehicles to the improvement of urban space is largely related to the design of urban space.

2.4. Old-Fashioned Infrastructures

Equipped with advanced sensors and artificial intelligence, self-driving vehicles that can draw their own route, follow the route, determine the external factors in their environment and control themselves accordingly, are one of the basic elements of the mobility of the future. Today, cars spend 95% of a day parked.[83] It gives us a clue that parking spaces occupy enormous spaces within urban space, often for the storage of stationary cars. The autonomous vehicle, which gets rid of its driver and becomes independent, does not have to remain inactive and parked when not in use. It can be requested by someone else and has the potential to respond to that request. Therefore, autonomous technology allows the vehicle to be shared. According to OECD, shared autonomous vehicles have the potential to meet the transportation need with 10% of the existing vehicles.[84] As a result of the proliferation of shared car applications, this means that fewer parking spaces are required to store vehicles. Today, there are 8 parking spaces for each car in America.[85] Although this data may seem striking, it is an inevitable consequence of the individual's need to park his/her car at each stop. The area covered by parking lots alone corresponds to about 5% of the urban land in the United States.[86] In order to be able to build a building according to the zoning laws, the necessity of making a parking lot that can meet the amount of cars that need to be accommodated increases the construction costs significantly. For example, the number of beds in the hospital, the number of seats in the conference room, or even the number of holes in the golf course are inputs that reveal how many car parking spaces are needed (Figure 44).[87] The automobile, which seems to be an indispensable part of daily life, is a decision-making mechanism in the construction of urban space. However, the

Shopping centers (small strip-style centers)	6 per 1,000 square feet of retail floor area for centers with up to 30,000 square feet; 5 per 1,000 square feet of retail floor area for centers between 30,000 square feet and 60,000 square feet
Nursing homes, personal care, adult care residences and assisted living care facilities	1 per 4 beds, plus 1 per employee on primary shift
Hospitals	1.8 per bed
Libraries, museums or galleries	1 per 400 square feet of floor area; 10 minimum
Swimming pool	3 per thousand gallons of water
Rooming houses, boardinghouses, tourist homes and bed-and-breakfasts	2 per single-family dwelling, plus 1 per guest room
Motels, hotels and lodges	1 per room, plus appropriate spaces for restaurants and meeting rooms
Assembly halls and meeting rooms	1 per 3 seats
Gentleman's club	1 per 4 seats; 30 minimum
Commercial cemeteries	25 minimum
Movie theaters	1 per 4 seats
Indoor recreation	1 per 200 square feet of floor area
Golf courses and driving ranges	3 per hole
Miniature golf and driving ranges	2 per tee for the first 36 tees, then 1 per tee
Campgrounds	1 per campsite
Restaurants	1 per 100 square feet of seating floor area

Figure 44: Zoning regulation showing the minimum parking requirement for new buildings/facilities (Source: Vox, The High Cost of Free Parking)

83. Paul Barter, "'Cars Are Parked 95% of the Time'. Let's Check!," Reinventing Parking, Last modified February 22, 2013, https://www.reinventingparking.org/2013/02/cars-are-parked-95-of-time-lets-check.html.

84. "How Shared Self-Driving Cars Could Change City Traffic," International Transport Forum- Organisation for Economic Co-Operation and Development, Last modified 2015, https://www.itf-oecd.org/sites/default/files/docs/15cpb_self-drivingcars.pdf, 5.

85. The High Cost of Free Parking, Vox, 2017, https://www.youtube.com/watch?v=Akm7ik-H_7U&ab_channel=Vox.

86. Daniel Herriges, "Parking Dominates Our Cities. But Do We Really *See* It?," Strong Towns, Last modified November 27, 2019, https://www.strongtowns.org/journal/2019/11/27/parking-dominates-our-cities-but-do-we-really-see-it.

87. The High Cost of Free Parking, Vox, 2017

fact that the autonomous vehicle and shared mobility mode will take an active part in daily life has the potential to completely transform this situation.

It is predicted that the need for parking will decrease as the autonomous vehicle has the ability to park after unloading its passengers and the shared transportation scenarios become widespread. MIT Senseable City, which carries out speculative studies on the urban scenarios of the future, has prepared a projection on how shared autonomous vehicles will affect parking scenarios by considering Singapore. Basically, an owned vehicle requires parking at each destination. When the vehicles start to support autonomous and shared movement mode, when the journey is over, the vehicle will continue its activity for another passenger instead of searching for a parking space. Based on the data obtained by MIT, the estimated parking spaces are equivalent to an area of 15.8km², which corresponds to 2.2% of Singapore's land today. They predict that the transition from private cars to fully shared autonomous vehicles will result in an 87% reduction in parking spaces (Figure 45).[88] According to Deloitte's projections, by 2050, shared and autonomous vehicles will provide approximately 80% of daily mobility (Figure 46).[89] The increasing prevalence of shared and autonomous vehicles seems to increase the traffic density while making it easier for the elderly, disabled and underage individuals who have difficulty in going out on the road alone.

With the acceptance of shared mobility modes in society and electric vehicles replacing fossil fuel vehicles, the act of parking in urban space and parking typology seem to be completely transformed. Local governments are making efforts to transform their future urban planning with the promise of less parking and more pedestrianized space. Perkins & Will has published a study on how mobility patterns and trends will affect urban space in the near future. They identified 4 key principles of what parking should look like in the future: Reduce overall supply, future-proof parking, electric capable parking and active surface parking. In order to reduce aggregate demand, it is necessary to replace it with maximums instead of meeting the minimum requirements for parking. Establishing regional parking networks instead of existing parking lots in neighborhoods will also contribute to this. In the future, the areas reserved for car parking should be designed as flexible flat surfaces that can serve functions other than parking spaces. There should be charging units in the parking lots that allow the charging of electric vehicles, which will be indispensable for the future. Non-park usage areas need to be designed or repaired in a way that encourages active use.[90] They released a

88. "Unparking," MIT Senseable City Lab, accessed April 16, 2023, https://senseable.mit.edu/unparking/.

89. Scott Corwin et al., "The Future of Mobility: What's next?," Deloitte, Last modified 2016, https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/consumer-business/deloitte-nl-ths-future-of-mobility-whats-next.pdf.

90. Aaron Knorr, Designing for Future Mobility: Developing a Framework for the Livable Future City Vancouver, British Columbia: Perkins + Will, 2018, 24.

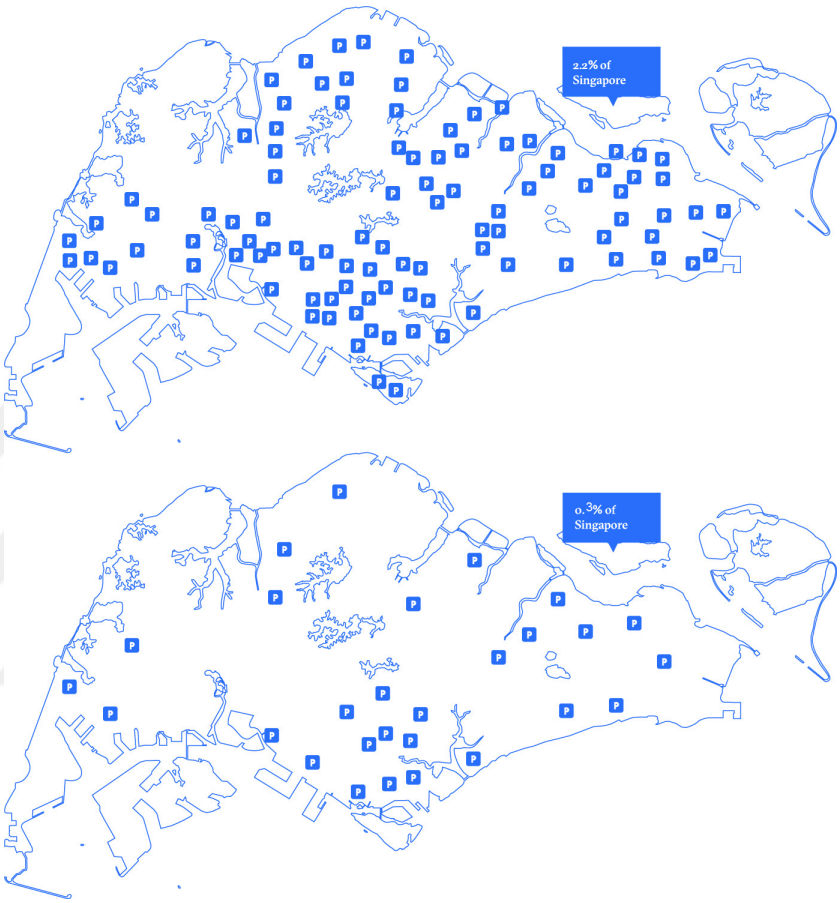


Figure 45: Top, ratio of parking spaces to total area in Singapore today, bottom, ratio of total parking areas in Singapore according to future projections (Source: MIT Senseable City Lab)

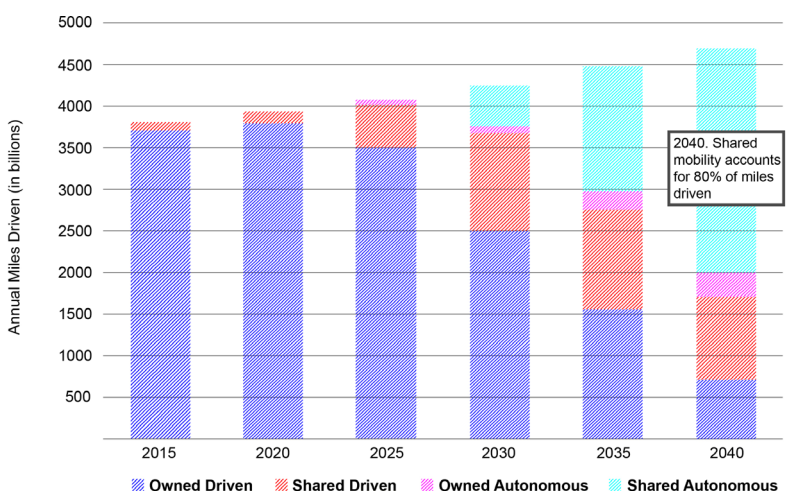


Figure 46: Annual distances traveled by automobile by mobility mode (Source: Deloitte)

comparative image that explains how the act of parking, combined with the scenarios mentioned, will affect the urban space (Figure 47). The most important thing that draws attention in the visual is undoubtedly the more active use of the urban space in the focus of pedestrians, compared to the current situation. They predict that reducing the surfaces reserved for automobiles or reusing them to be mixed-use will contribute to the active use of urban space by pedestrians.

German automobile giant Audi announced its studies on future mobility under the title of "Audi Urban Future Initiative" in 2015. According to Audi, the integration of future mobility with the city depends on the infrastructure readiness of the cities. Significant transformations are required in the urban fabric in order for autonomous vehicles to perform fully. Therefore, they stated that they will take steps together with professionals, architects, city planners, real estate developers, municipalities, CEOs, from different disciplines to advance these researches. They explained their vision as creating a more sustainable, livable and people-centered city. They focused on the issue of parking, which is one of the most important problems of urban space. They worked on two different pilot projects in Boston's Somerville area on how parking should evolve in the future, along with driverless vehicles and artificial intelligence systems.

A mixed-function real estate project planned on a former industrial estate in Somerville's Assembly Row, a 7-minute drive from Boston, has been selected as one of Audi's pilot projects. The legislation requires a particular quantity of parking spots per residential or commercial unit, accounting for approximately 40 percent of the total area.[91] This means that, as can be expected, very large areas will be occupied by vehicles as parking spaces. However, this situation seems to be completely transformed as the human factor disappears and the vehicle becomes self-parking.Audi claims that 2 square meters of space per vehicle can be saved by removing people from the parking act. When we consider a multi-storey car park, when the human factor is completely disabled, there may be no need for vertical circulation elements such as stairs and elevators. In addition, as a result of the driverless vehicle offering a more error-free drive, the lanes on which it will move in the car park may narrow. Detecting which car to use and when has the potential to significantly save parking space. Thanks to this data, it can be determined which vehicle will park where. In this way, more than two parking rows can be stacked sequentially. At the same time, driverless vehicles have the

91. Audi Urban Solution | Assembly Row Archdaily, 2015, https://www.youtube.com/watch?v=DmW1RvgNj5k&ab_channel=ArchDaily.

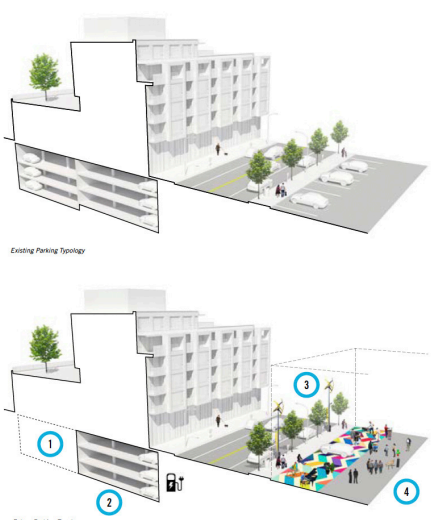


Figure 47: On the top, a section of the urban space shaped according to the traditional act of parking; on the bottom, a section of the urban space shaped according to future parking scenarios (Source: Perkins&Will)

opportunity to park more perfectly than the human operator. Since one of the vehicles will not get off after the parking action and therefore the vehicle door will not open, a smaller parking space will be sufficient for the vehicle (Figure 48). If all these optimizations are realized, Audi promises a 62% reduction in the areas reserved for parking spaces (Figure 49).[92]

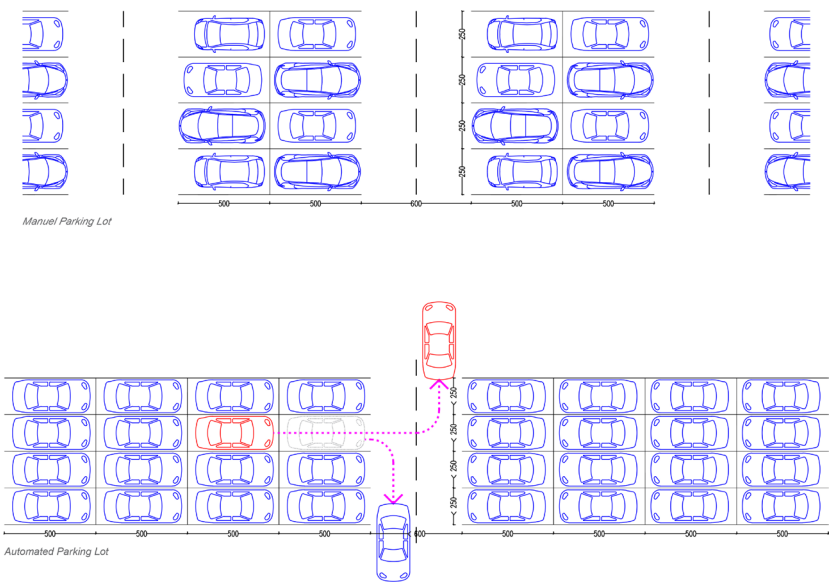


Figure 48: Comparison between a conventional parking lot and an autonomous parking lot

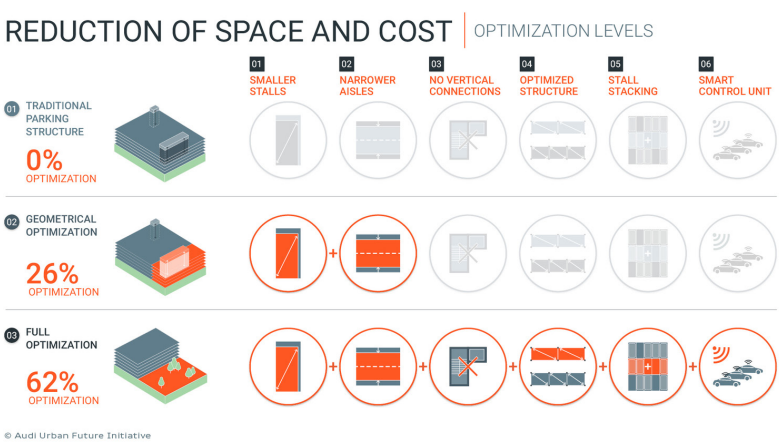


Figure 49: The potential of an Audi-optimized parking space (Source: Audi)

Another pilot project of Audi, also located in Somerville, emerged with the aim of controlling the traffic in Union Square, one of the busiest locations in the region. Audi believes that in order to control traffic, curbside parking lots and cars seeking parking must be removed from traffic. Traffic is not only created by vehicles trying to reach their destination while driving.

92. Becky Quintal, "Smart Moves for Cities: The Urban Mobility Revolution Will Start With These 3 Projects," ArchDaily, Last modified November 25, 2015, https://www.archdaily.com/777791/smart-moves-for-cities-the-urban-mobility-revolution-will-start-with-these-3-projects.

Approximately 30% of the traffic volume is generated by drivers looking for parking spaces during rush hours.[93] At the designated drop-off points for vehicles, drivers will leave their vehicles and the vehicles will be able to park at a designated spot for them (Figure 50). Thus, the need for on-street parking spaces and the traffic created by vehicles seeking parking spaces will be eliminated. It will facilitate the construction of parking lots outside the urban attraction points; therefore, there will be no need to park vehicles within walking distance anymore. Park areas that cover large areas in urban attraction areas can be re-functionalized with various functions and brought to the city and urban residents.

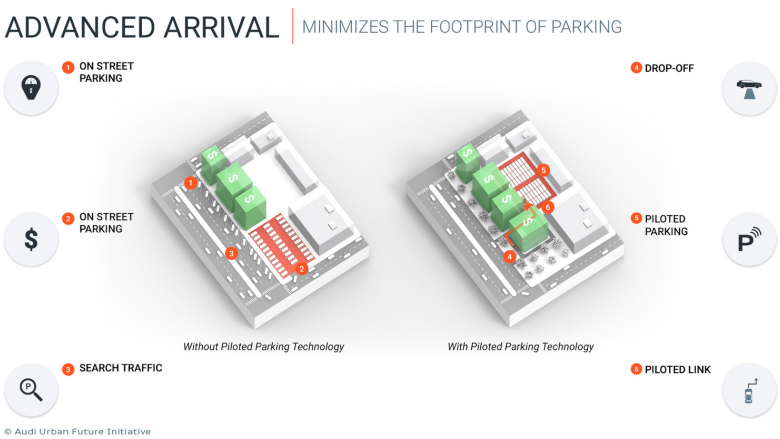


Figure 50: Parking organization of Audi (Source: Audi)

The transformation of the traditionally known car into a self-driving robot seems to have the potential to radically transform today's urban space. Switching its control from human to artificial intelligence will save it from being used on individual initiative. A car freed from individual initiative will have to adhere to strict rules set in the city. Therefore, it will contribute to the democratization of urban mobility. It will also help transform the tendencies of societies towards mobility. The automobile, which is an object of possession, will become a part of the sharing economy as a result of its acquired capabilities. How will the city be affected by this situation in a scenario where its shared use is accepted by the society? It seems very difficult to give a definite answer. However, it seems that the large areas dominated by the automobile in today's city can be regained to the citizens.

93. "How Much Traffic Is Caused by Searching for a Curbside Parking Spot?," Wiki Motors, accessed April 28, 2023, https://www.wikimotors.org/how-much-traffic-is-caused-by-searching-for-a-curbside-parking-spot.htm.

Conclusions

The automobile, which is one of the indispensable elements of daily urban life, has been one of the critical elements in the construction of urban space throughout its short history. Wide streets, multi-lane highways and viaducts have been built for the movement of the automobile, which accelerates as you press the gas pedal and offers freedom and a provocative experience to human beings. In order to ensure the uninterrupted flow of traffic, the old neighborhoods were destroyed or fragmented, the dominance of the streets where pedestrians roam freely was left to the automobile, and the pedestrian was condemned to the sidewalks left over from the automobile. In order to preserve the stationary car, a not to be underestimated area has been reserved as a car park in the urban space. In other words, the automobile has become a provocative element in the production of urban space.

The automobile, which makes it easier for human beings to reach locations at a distance that they could not imagine before, has led to the emergence of new urban typologies that fully serve itself and its passengers. In addition to infrastructural elements such as wide streets, highways and viaducts where the car moves, many facilities have emerged that serve the car traveling on the highway and its passengers. Examples of these are shopping malls with a large number of parking spaces, gas stations where the vehicle can fill its tank and meet the basic needs of its passengers. In addition, motels and fast-food restaurants can be included, where passengers can take a break and rest, meet their nutritional needs, and sometimes spend the night during long journeys. In other words, urban space has become a topography that is almost completely consumed by the automobile and its passengers. The city, shaped by the dominance of the automobile, has begun to limit the efficiency of the pedestrian.

Until the past few decades, the automobile was seen as a superhero, keeping mankind up to speed with the modern age. The mobility ability that it brought to human beings at a level that was unimaginable before had made the automobile one of the indispensable elements of daily life. However, the meaning that mankind attributed to it was enough to significantly affect the fate of the urban space. The traffic and the noise it created, the toxic gases coming out of the exhausts of the automobiles adversely affected the quality

of the urban space and the physical and mental health of individuals. The devastating effects it creates day by day are better understood. The states, which have a strong belief that electric vehicles, which are expected to be the new toys of the near-age, will change this situation, are planning to remove fossil fuel vehicles from circulation by 2030. They believe that electric cars that can be charged and without exhaust will improve the quality of life of the urban space. In this context, they provide incentives for the sale of electric vehicles and lead the establishment of new infrastructural elements such as charging stations.

The number of electric vehicles, one of the new players in the urban space, continues to increase day by day. Electric vehicles powered by the huge battery in their body are plugged in and charged, just like our mobile phones. Although the act of charging seems like a very simple act in theory, the issue of where and how the electric vehicle will be charged causes it to be a factor that the vehicle owner should consider when planning his journey. Before setting off, the individual makes his choice of route in favor of the route where the charging stations are located, taking into account the charging status of the vehicle. If he has a charging unit on his property, he charges his vehicle before the trip. A petrol vehicle only needs a few minutes to fill its tank, while an electric vehicle takes 30 minutes at best to recharge its battery. However, the possibility of charging electric vehicles at every point where the electrical infrastructure is provided seems to reduce the dependence of vehicles on monopolized facilities. This immediately brings to mind the question: What will happen to gas stations? In today's city, gas stations with substantial real estate lands serving nothing more than to fill the vehicle's tank and meet a few basic needs of the passengers usually consist of fuel tanks under a typical canopy and markets and toilets in an enclosed volume. As a result of the very short refueling times, gas stations are usually short-term haunts. Therefore, it does not promise much to its user in spatial terms. However, the fact that the charging times of electric vehicles are quite long compared to refueling means that the individual has to wait longer during charging. The change in the time factor and the fact that the individual has to wait longer while the vehicle is charging seems to create an opportunity for the physical space to be shaped in the focus of the individual. Thus, James Silvester's proposal does not seem like a utopian idea at all. It seems that the individual will reach a place where he can perform various daily activities and socialize from a place where he can only meet his basic needs and get gas in transit (Figure 51).

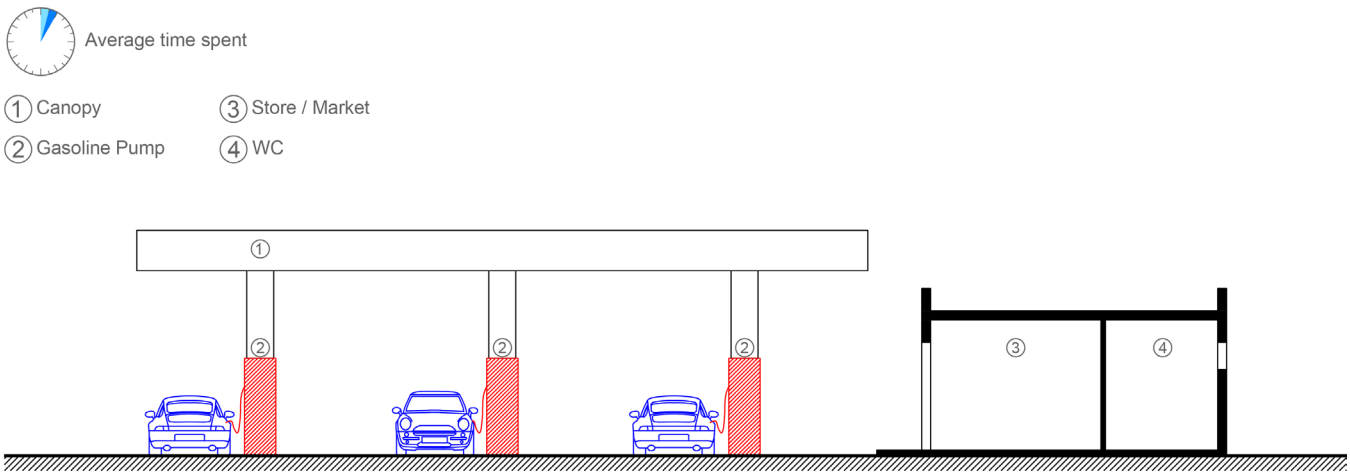


Figure 51: Comparison of a typical gas station with a potential charging station of the future

City centers are being redesigned as spaces that are restricted to vehicle traffic or free from cars. As in the past, it is desired to be transformed into public spaces where pedestrian flow and interaction are ensured in a healthy way. The evolution of the automobile industry and new mobility trends seem to contribute positively to the improvement of urban space. What is meant by improvement, seems to be to find an answer to the question of whether the urban space, in which the automobile has established a great dominance, can be redesigned by focusing on the individual, as in the pre-car city. Beyond electric cars, autonomous vehicles are predicted to be the most important figures that will shape the mobility of the near future. It is believed that the transformation of the car into a robot controlled by artificial intelligence, by removing the steering wheel and the driver, will create an opportunity to shape the cities built for the movement of the traditional car in a pedestrian-oriented manner. In addition, the potential for self-driving vehicles to become a part of the sharing economy is thought to provide an opportunity to bring many areas reserved for automobiles in today's city to the residents of the city. The decline in vehicle purchase rates and the tendency of societies towards shared mobility applications indicate that daily transportation needs can be met with fewer cars in the future. According to the claim of Stephan Moss, the potential of a single car to meet the daily transportation needs of 60 people supports this claim. Based on these assumptions, how does the decrease in the number of vehicles and their transformation into a robot controlled by artificial intelligence have the potential to affect the fate of the urban space?

The automobile industry is thinking a lot about what the city of the future will be like. They aim to build cities from scratch in order to test the potential of driverless cars and their integration with urban space and the citizen. These cities are considered as laboratories where autonomous vehicles, artificial intelligence and new technologies are tested. When we look at these newly designed cities, it is striking that they have a homogeneous and regular plan, almost as much as a Corbusier city. However, unlike the city of Corbusier, it stands out that they were designed with an understanding that gives equal importance to all mobility modes, rather than being a city dominated by the automobile. It consists of specially designed paths for each mobility mode, as well as surfaces with equal transition superiority, which supports Monderman's Shared Space idea at encounter points. Accessing the shared surface, the driverless car continues its movement without usurping the right of way of others. This allows the democratic use of surfaces defined

as shared spaces. However, all these ideas are interpreted through ideal cities that will be created from scratch. Discussions on how today's cities can transform with autonomous vehicles and adapt to the new form of the automobile remain very limited.

For example; can autonomous vehicles support mobility in a city like Istanbul, which develops quite organically and has a rugged topography? How can urban space adapt to the new state of mobility and the automobile? It is not possible in the short term to eliminate all traditional vehicles in the city and replace them suddenly with driverless vehicles. However, in some designated pilot areas of the city, the potential of autonomous vehicles and their integration with the city and its inhabitants can be tested. In this context, Bağdat Caddesi and its immediate surroundings, an important trade axis stretching from Kızıltoprak to Maltepe, where both pedestrian and vehicle traffic are quite intense, can create a suitable environment where the potential of autonomous vehicles can be tested. Today, the street, which is open to one-way vehicle traffic, consists of three lanes. Traffic flows from Bostancı towards Kadıköy. In the traffic direction, on the right side of the street, there are pockets where cars can park. Pedestrian circulation is quite intense depending on the shops and workplaces, especially in the section of the street between Suadiye and Caddebostan. In addition, the sidewalks in the aforementioned part of the street are quite wide. However, crossing to the other side of the road is provided by the pedestrian crossings at the intersections, which are controlled by the traffic lights due to the fast flowing traffic. Vehicles occupying the sidewalks are prevented with the help of bollards on the sidewalks. However, there are parking pockets for vehicles on the sidewalks in the direction of traffic flow. In the side streets that cross the street, one side of the road is usually reserved for parking. It is quite difficult to stop and find a parking place (Figure 52).

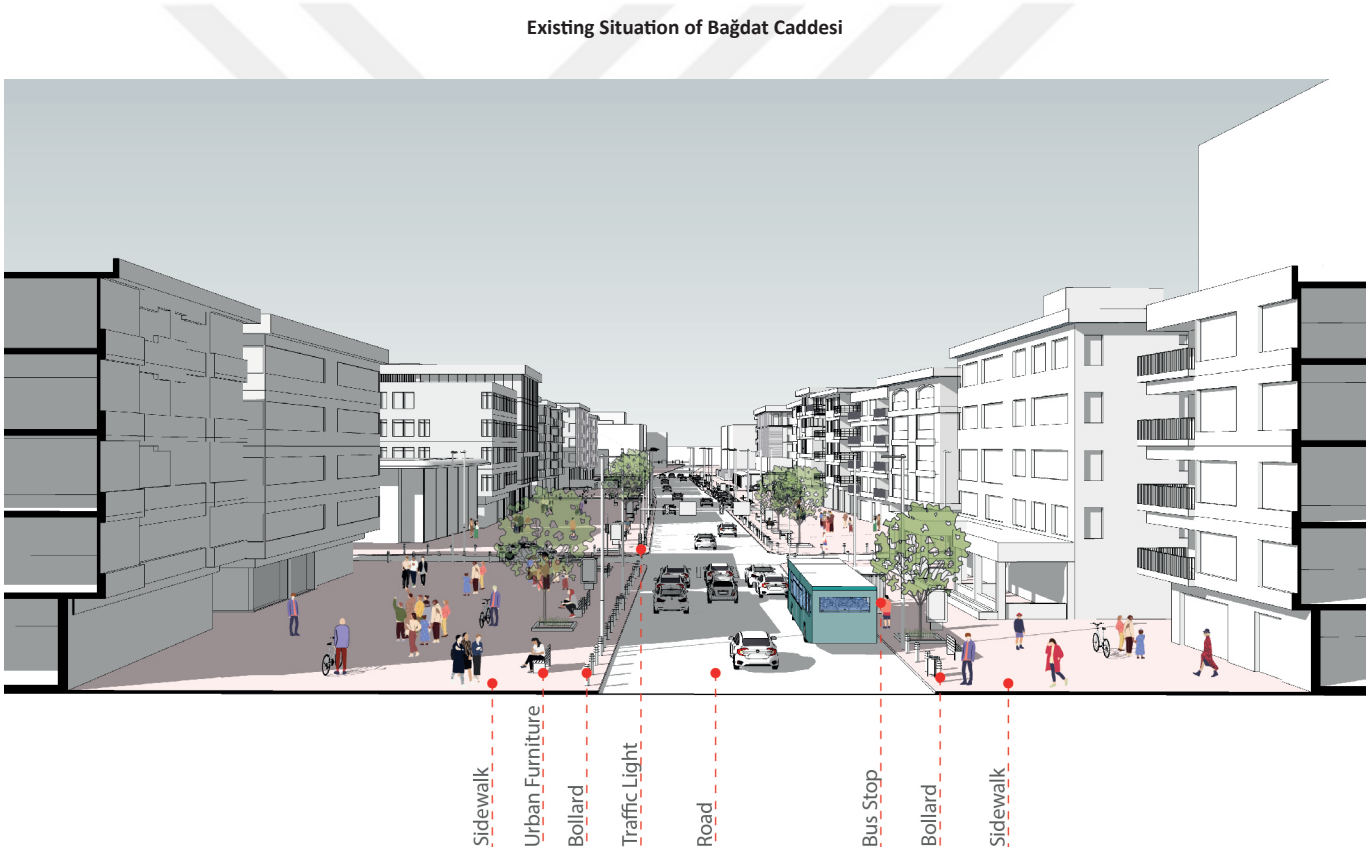


Figure 52: A traffic light-controlled intersection on Bağdat Caddesi, a curbside pocket reserved for the bus stop

The introduction of autonomous vehicles on Bağdat Street, which has been selected as the pilot area, and its immediate surroundings can help the area become free of automobile dominance and turn it into a pedestrian-first place. The absence of traditional human-controlled vehicles in the region should be considered as a prerequisite for achieving the determined goal. Because in the urban space dominated by human-controlled vehicles, the existence of traditional and infrastructural elements that regulate traffic inevitably emerges: traffic lights, sidewalks reserved for pedestrians, bollards that prevent vehicles from occupying the sidewalks, pedestrian crossings, curbside parking lots...

In addition to the fact that the car has become driverless, being a part of the sharing economy is one of the important factors that will determine the fate of the urban space. Because the vehicles becoming part of a social network that individuals can rent in line with their needs has the potential to reduce the number of vehicles in traffic. As a result of the decrease in the number of vehicles as expected, the number of lanes needed may decrease. It can also lead to narrowing of lanes, as the autonomous vehicle is expected to offer a more accurate driving experience compared to a conventional car controlled by a human operator. In a scenario where the aforementioned conditions are met, two 2.5-meter-wide surfaces are defined that will be used primarily by autonomous vehicles along Bağdat Street, which has a very linear route. These surfaces are planned to enable autonomous vehicles to move efficiently. Adhering to the established regulations, the driverless vehicle will not exceed the speed limits and will stop when necessary to give the pedestrian right of way. When it leaves the lane reserved for it, it will reach the shared surface where all mobility modes are given equal priority. When it reaches the shared surface, it will accompany the speed of pedestrians in motion and will not usurp anyone’s right of way. When it reaches the lane reserved for it again, it will accelerate and continue its movement. As the total number of lanes and road width decreased, the pedestrian-oriented shared surfaces expanded. While trying to support pedestrian mobility in an uninterrupted way, shaded areas where individuals can breathe are created thanks to the urban furniture and trees placed (Figure 53).

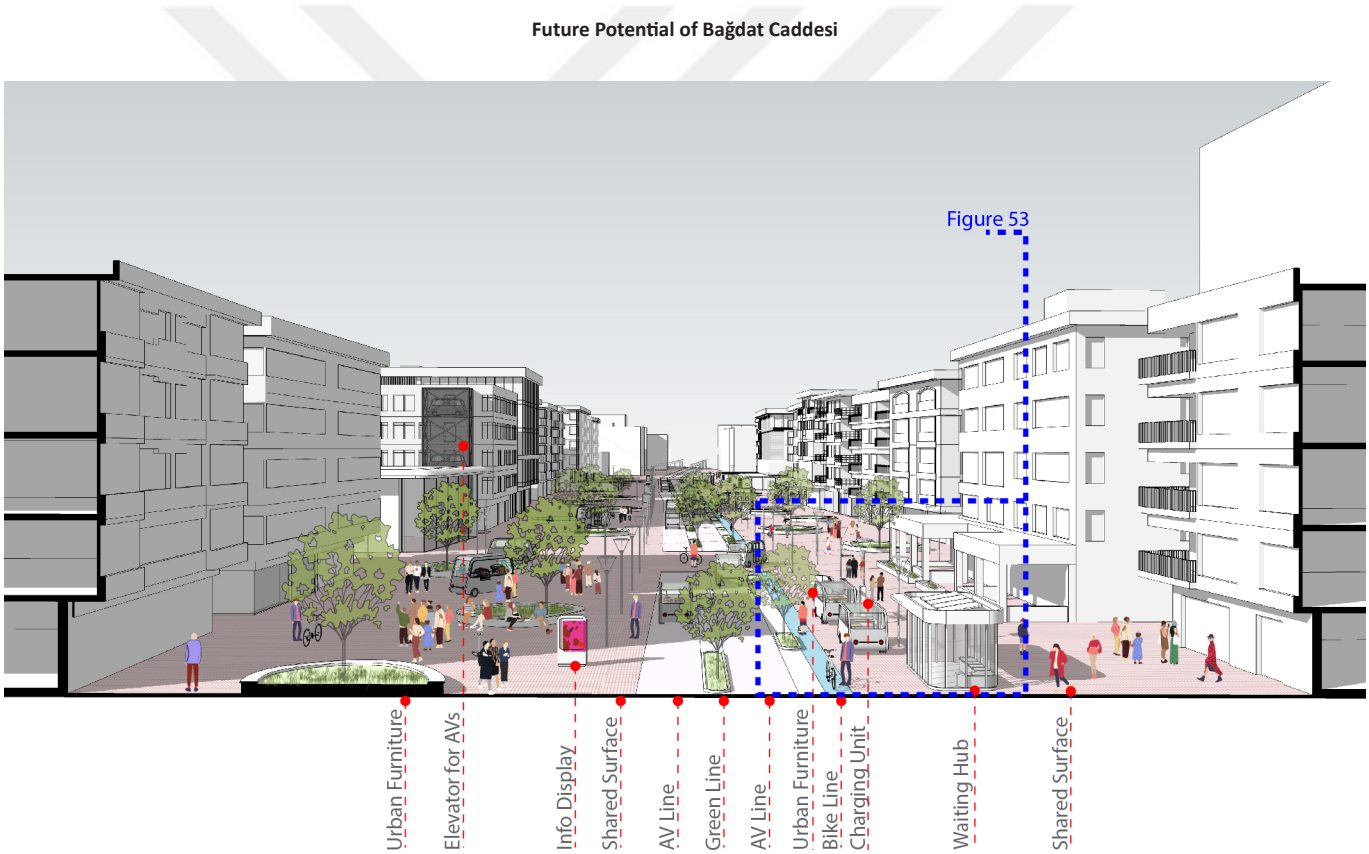


Figure 53: The intersection where the lanes reserved for vehicles and bicycles meet with the shared surface, waiting hub for passengers waiting for a taxi, urban furnitures on shared surface, charging units

An individual on Bağdat Street does not have to wait and follow the bus passing only at certain hours in the near future. Because public transportation is provided by robo taxis that individuals call with the help of the mobile app they download to their mobile phones. The individual can wait the taxi inside the waiting hub, which will replace the bus stop. Thus, during the waiting period, he/she can protect himself/herself from possible bad weather conditions. The energy needed by the hub is provided by solar panels on its roof. Thus, individuals inside the hub can charge their mobile phones and surf the Internet. There are charging units right next to the hubs. Vehicles that need charging can stop for a short time and meet their needs. Mobility in the region is not limited to pedestrian movement and automobile. Alternative transportation methods such as bicycles and e-scooters also significantly support mobility. To the right of the lane reserved for driverless vehicles, a lane is reserved for bicycles and e-scooters. In addition, urban furniture has been placed on the right side of the lane, where the citizens can sit and breathe, and park their bicycle or e-scooter. The road pockets, where vehicles can be parked on the side of the road and where buses stop to pick up passengers, have begun to lose their former function. These pockets have now turned into surfaces where waiting Hubs, charging units, urban furniture housing bicycle and e-scooter parks are located (Figure 54).

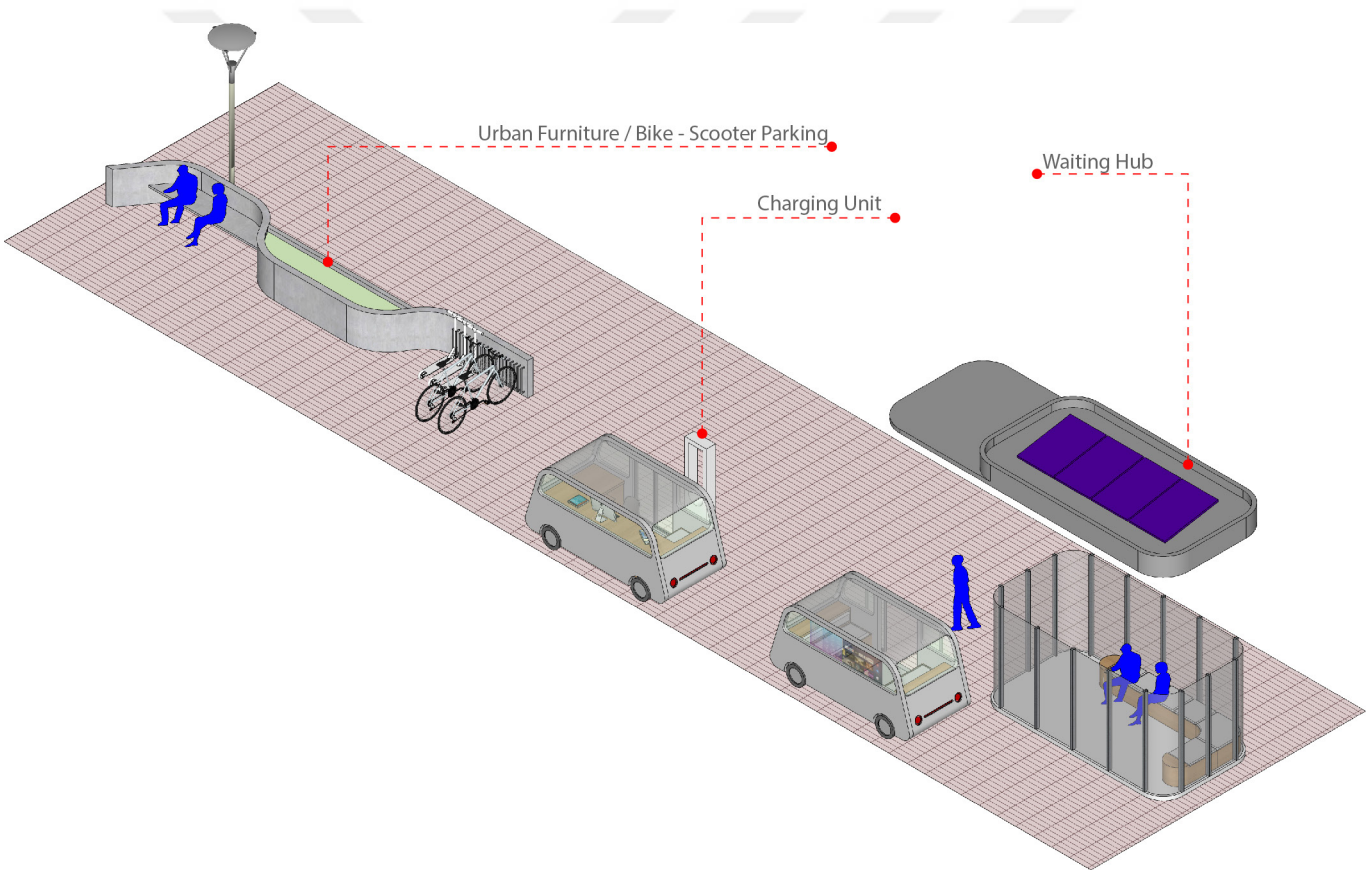


Figure 54: The new state of the road pocket: Waiting Hub, Charging Dock, Urban furniture with bicycle and E-scooter parking

The issue of parking on Bağdat Street stands out as a serious problem. There are parking spaces for vehicles both in the pockets on the sidewalks on the street and on one side of the side streets that cut the street. In addition to these, there are closed car parks in the basements of some buildings. However, considering the density of the area and the current state of the streets and side streets, it is clear that the parking spaces are insufficient. When the cross section of a shopping center located on the street is examined, it is seen that it has a car park consisting of two basement floors (Figure 55). Today, it is estimated that this parking lot is far from meeting the needs of the region. However, this may change completely as self-driving cars take over from traditional vehicles. In the scenario where driverless vehicles are used in a shared manner, the need for parking has the potential to decrease. Because after the vehicle has unloaded its passenger, if there is no need for charging, it will continue to move to pick up another passenger. However, if not called by another passenger, it will search for a parking spot by itself and perform the parking action more perfectly than a human. Therefore, the areas needed for car parking will be reduced. Considering that the vehicle performs the parking action in a more perfect way and that the vehicle's door will not be opened afterwards, the dimensions of the parking space for one vehicle will also decrease. As a result of the decrease in the need for parking spaces, one floor of the parking lot of the shopping center will turn into a physical space that the residents of the city can use for various purposes (Figure 56).

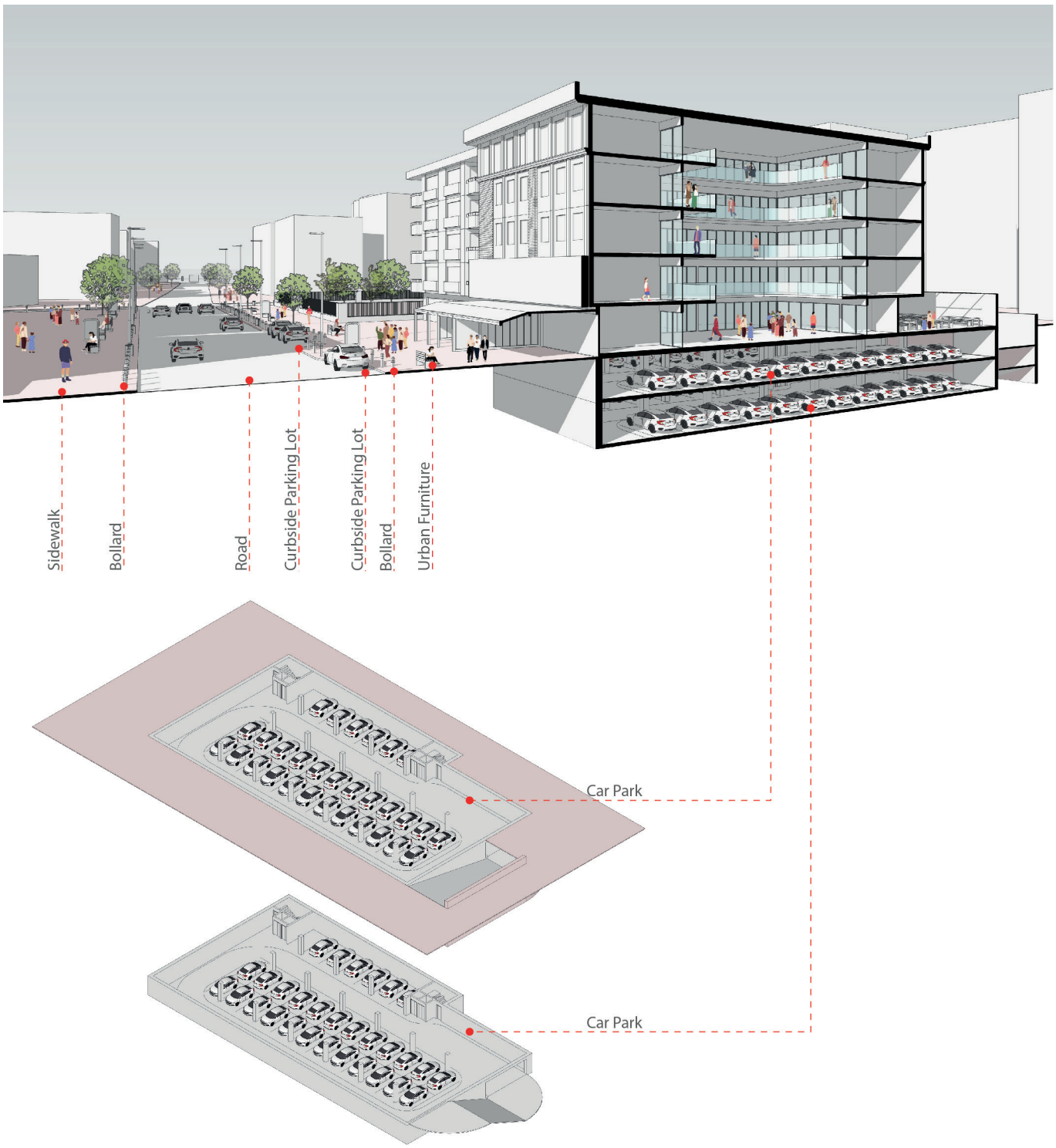


Figure 55: The current state of the shopping center with a two-storey car park

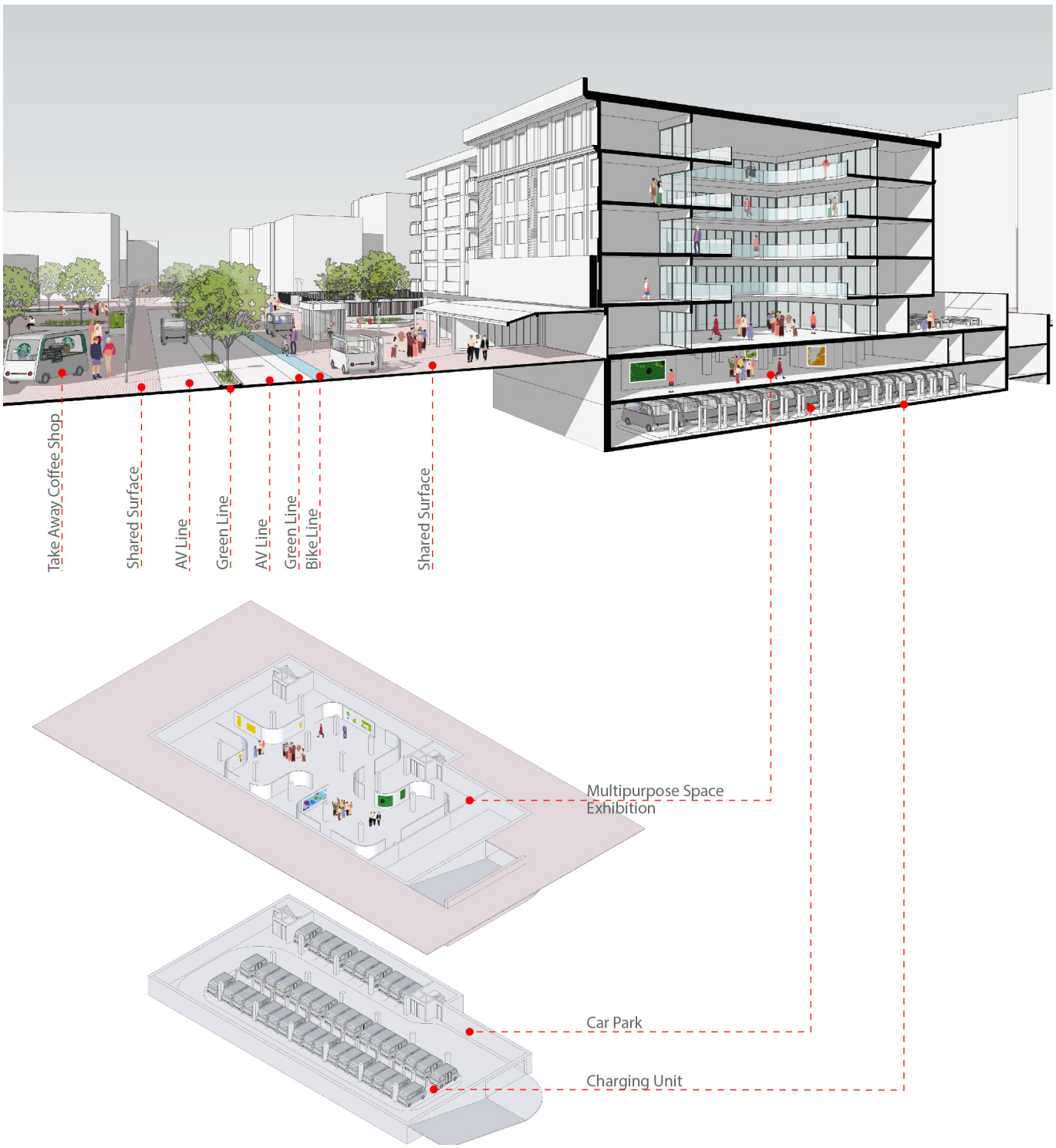
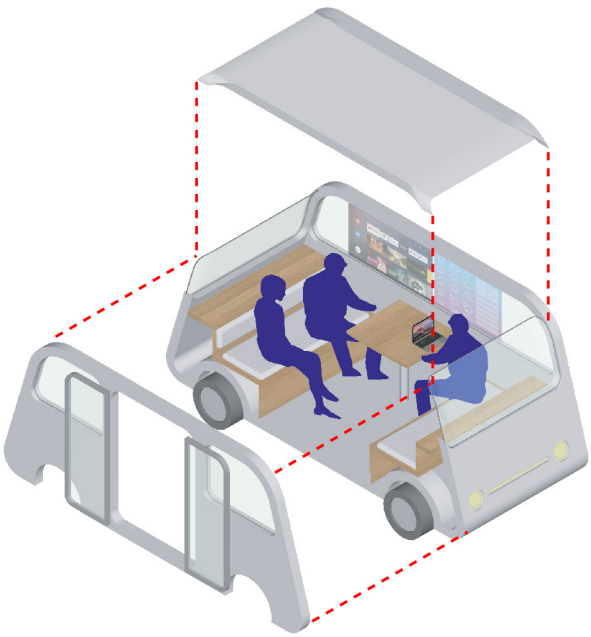


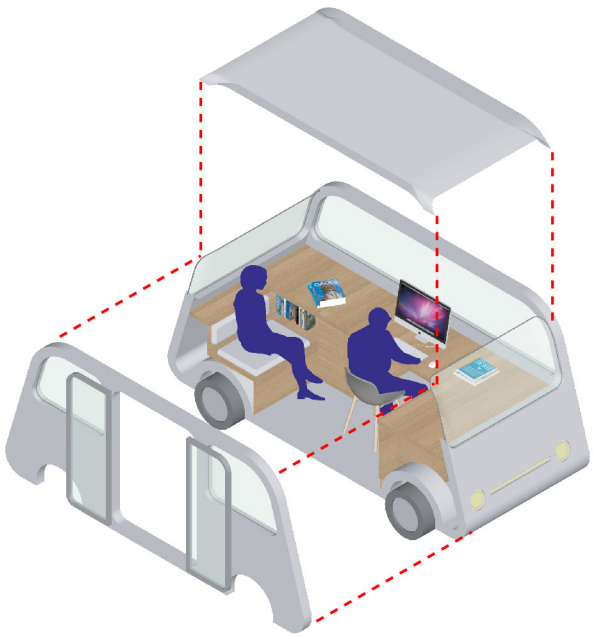
Figure 56: Conversion of one of the parking floors to an exhibition space, and adaptation of the parking floor to driverless and electric vehicles

Self-driving vehicles, which are responsible for transporting individuals within urban space, also seem to promise much more than the physical space offered by a conventional automobile. Passengers who are no longer responsible for the control of the vehicle do not have to look at the road and follow the traffic. Therefore, he can have a physical space where he can completely spare time for himself during the journey. The absence of a steering wheel, that is, the interior does not have to be shaped according to the driver, will allow the interior of the car to be transformed in various ways. "Robotaxi", where four people can travel at the same time, follow the latest news and watch movies thanks to its interactive screen during the journey, and "Working Hub AV", where the individual can handle their daily work during the journey, can be given as examples. In addition to these two, AVs operating as a coffee shop serving with a robotic barista can be included, as well as AVs operating as a small business serving as a brand's pop-up store. They can be programmed to serve at different times and at different locations on the street, and can serve as mobile businesses that individuals call to their feet upon request (Figure 57).

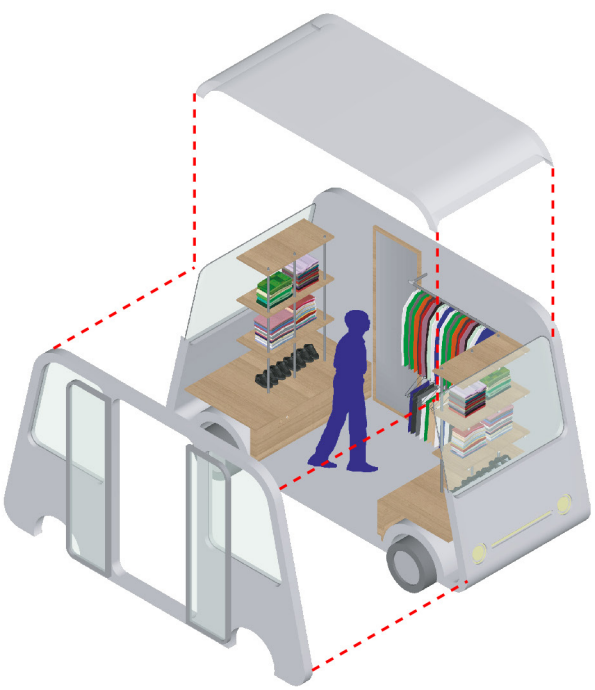
The human dominance over the car, which has been controlled by the same principles for nearly a century, comes to an end. Artificial intelligence takes over the human operator. It is clear that the car, controlled by artificial intelligence, will reshape the urban space. It is predicted that the city will significantly support pedestrian movement again and that the effectiveness of vehicles will be limited. They claim that pedestrians, who are condemned to the pavement due to the dominance of the automobile, will retake the dominance of the urban space together with the technological level reached by the vehicles. The dream of a city where the pavement, which draws a sharp boundary between the car and the pedestrian, will disappear and we will reach level surfaces. However, the situation shows that; The automobile will once again have a say in the production of urban space. However, it will be able to create a more free environment for pedestrians. In fact, it will be the evolving mobility trends of societies, rather than the automobile, that will transform urban space. The automobile is changing; however, the way the car is used rather than the car is transforming. The motion of the automobile will be in the future as it is today. However, the way it is used will be the only factor that really affects the fate of the urban space. In other words, not the automobile, but the mobility of the future will transform the destiny of the city of the future.



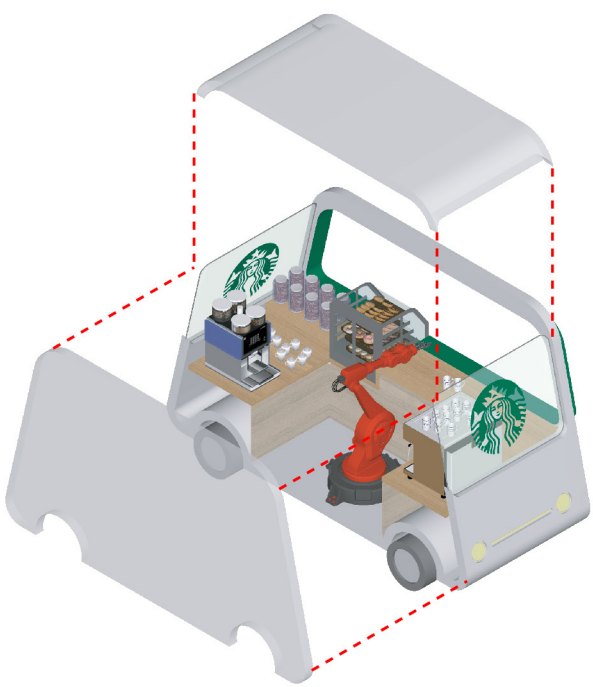
Robotaxi / Shuttle AV



Working Hub AV



Pop-up Store



Take Away Coffee Shop with Robotic Barista

Figure 57: AVs with interiors shaped according to needs

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